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SOILS, CHEMICALS, IRRIGATION, ENGINEERING AND ECONOMICS

A Howard Rotavator at work in a Cape Province Vineyard

VOLUME 4, No. 10 OCTOBER 1952

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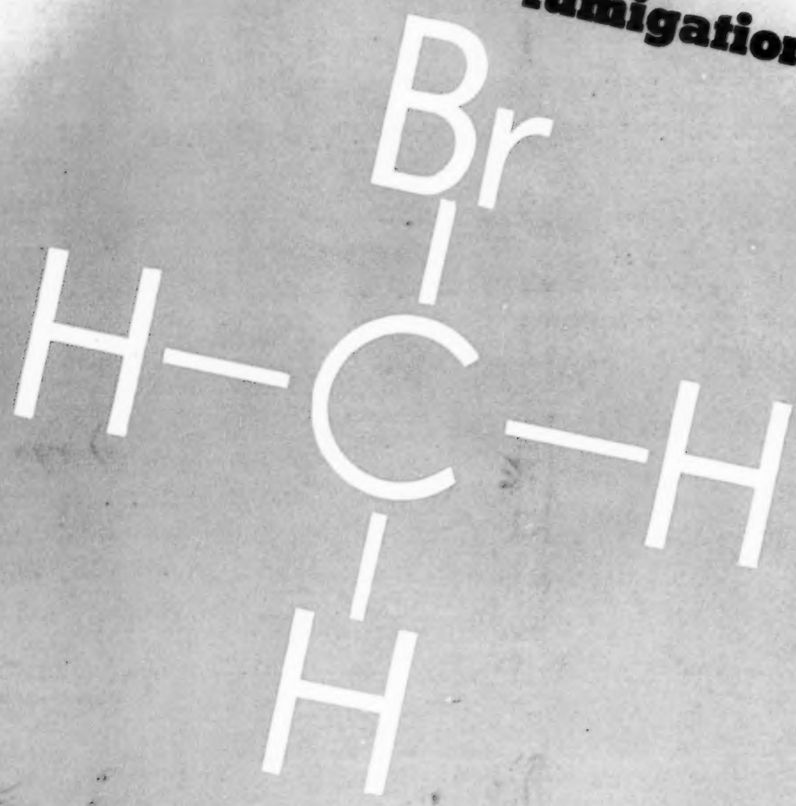

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WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

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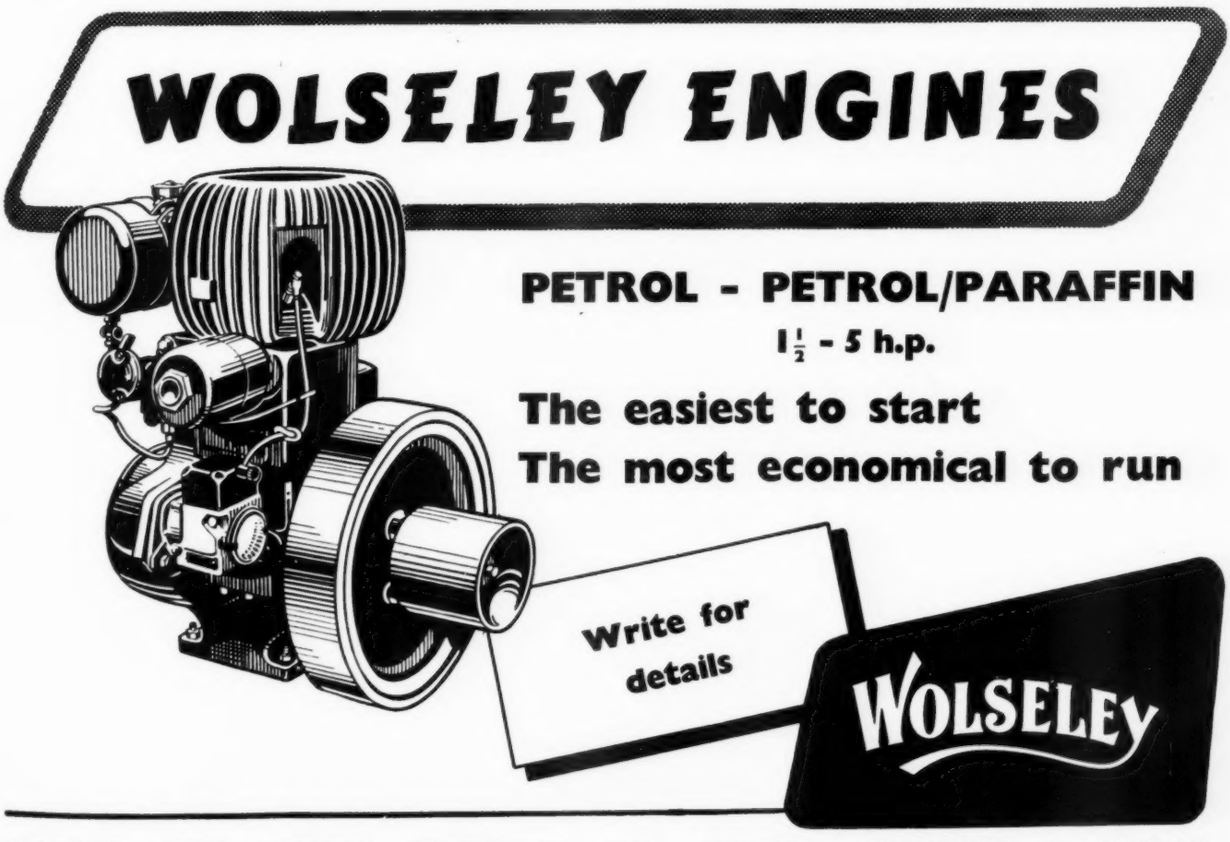
Rotavating in a Groot Drakenstein Vineyard

The cover picture shows a Howard Rotavator working with a Ferguson Tractor in an export vineyard at Groot Drakenstein, near Stellenbosch in the Cape Province of South Africa. The way in which the lupin cover-crop, as high as the wheels of the tractor, is being chopped up and turned in does much to explain the popularity of the Rotavator for vineyard and orchard work.



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Editorial Comment

Developments in Dutch Guiana

THE agricultural achievements of the Dutch in Indonesia deserve the respect and attention of all interested in tropical development. Since the disaster of the Japanese invasion local political aspirations, fostered and encouraged by international agencies, have, however, precluded the Dutch reassuming the influence they exercised before the war over the conduct of agricultural operations and agricultural development in that far-flung region. Instead there has developed a deep-seated belief that satisfactory development can be assured under the guidance of the newly established local authorities with help and assistance from international bodies.

Whether in fact this will in the end prove to be a well-founded belief remains for the future to show; certainly the vast knowledge and experience of tropical agricultural conditions which the Dutch scientists accumulated during their lengthy control of affairs in the former Netherlands East Indies represents a sum total of tropical agricultural know-how which is almost unparalleled and must not be lightly disregarded.

Deprived as they are of these great outlets in the Far East for their skill and energy, it is hardly surprising that the Dutch should now be turning their attention to their remaining tropical dependencies in the Western hemisphere which have, perhaps not unnaturally, fallen behind in the matter of the attention devoted to their development by their mother country.

Of these Dutch Guiana, or more familiarly the province of Surinam, is by far the largest and best known, and in this number of WORLD CROPS, Mr. D. H. Grist contributes an account of developments now in progress in that country.

Large areas in Dutch Guiana are particularly suited to developing rice growing, consisting as they do of front land which, provided it can be protected from inundation by the sea and adequately drained and irrigated, can be developed in rice, using mechanical methods of cultivation. The record of the Dutch in improving rice cultivation in the East Indies is outstanding, while their skill in empoldering and reclaiming marshy and inundated lands in Holland is so well known as to be almost a byword. Hitherto, development in Surinam has been impeded by a lack of knowledge and a scanty and doubtfully reliable labour supply. In the present scheme the aim is to encourage the emigration from Holland of Dutch farmers who will undertake the reclamation and development of farms in this region as part of the general plan of development, assisted by a grant of 40 million guilders from the Dutch treasury.

The hope is that this scheme may help to lessen the land shortage which is becoming increasingly felt in the Dutch motherland and at the same time eventually make a substantial contribution to the already deficient supplies of rice in a hungry world.

The attempt will be watched with the greatest interest and attention. The vast store of knowledge accumulated by the Dutch in the matter of rice growing and the management of water in their cultivation is sufficient guarantee that the matter will be handled with the necessary skill and judgment, while the success which during the past 100 years attended their efforts to improve rice cultivation in Indonesia affords grounds for believing that the prospects for the success of this venture are brighter than those which have attended some other ventures in the sphere of tropical development.

Spraying problems

THE current issue of WORLD CROPS contains several papers dealing with various aspects of applying washes and emulsions to crops in the form of sprays for the control of pests and diseases. We make no apology for this, since the depredations of pests and diseases at present take heavy toll of crops throughout the world, and in attempting to reduce these losses the effective applications of the chemicals employed is of first importance. Speaking at the Fernhurst conference in June 1951, Mr. S. W. Chieveley, then managing director of Plant Protection Ltd., stated that he was appalled at the wastage of plant protection products throughout the world and, referring to the consumption of BHC, mentioned that he doubted whether more than one-third of the total amount used in the world was really effective in killing insects; the remainder might very well be wasted.

Consequently, in devising new chemical methods for controlling pests and diseases it is necessary to have regard not only to the toxic potentialities of the chemicals and their formulations but also to take strict account of the method and manner in which they are applied to crops; these must ensure not only that the materials are applied in sufficient quantity in a physical condition which ensures that they act effectively but also that in achieving these ends there is a minimum of wastage, inasmuch as wasteful methods of application can add greatly to the cost of production.

Moreover, new pests and diseases often call for new methods of application. An example is the blister blight disease of tea which, although long known in Assam and northern India, has proved very difficult to combat under conditions encountered in Ceylon and southern India. In the case of this particular disease the need is to obtain maximum coverage, difficulties to overcome being the nature of the terrain and the climatic conditions of the countries where the crop is planted. To meet requirements in cases of this description the technique of drift spraying has been devised which demands accurate definition and control of the droplet size used in spraying, as well as of the manner in which spraying operations are conducted.

To evolve successful techniques for the performance of such operations demands a combination of the experience and skill of the chemist, the physicist, the machinery technician, the entomologist, the plant pathologist and the botanist. It is only as the result of the associated work of all of them that there can be any hope of solving the majority of the problems which tend to grow in difficulty and com-

plexity with the advance of knowledge; while each specialist in his own line must also understand and appreciate enough of the methods and limitations of his colleagues in other lines if collaboration is to be fully fruitful.

European fertiliser consumption

THE upward curve of fertiliser consumption in countries in the Organisation for European Economic Co-operation is falling off, and this is viewed with concern by the O.E.E.C. sub-committee on fertilisers, fungicides and insecticides. The vital need for a steady increase in the use of fertilisers was emphasised by the sub-committee in their first report, where it was stated, ' Provided fertiliser targets are achieved as planned, the anticipated increase in agricultural output will account for half the increase planned by participating countries by 1952-53.'

In 1949-50 fertiliser consumption in the participating countries amounted to 5.16 million tons in terms of the three main plant nutrients—nitrogen, phosphate and potash. In 1950-51 consumption increased to 5.70 million tons, 30,000 tons more than anticipated. However, according to the sub-committee's second report, consumption in 1952-53, far from reaching the level of 186% over pre-war consumption, is now thought likely to be little more than 147%. The increases achieved in some countries, especially the smaller ones, have been much better than anticipated. But these have been offset by the poor showing of other countries. In 1950-51, for instance, Switzerland achieved 219% increase over pre-war consumption. France, however, achieved an increase of only 22%. In the United Kingdom, the increase was 98%. The report notes some significant changes in the pattern of fertiliser use. Generally, consumption of nitrogen has risen compared with that of phosphorus and, to some extent, potash. Chilean nitrates are less used. Consumption of ammonium sulphate and calcium cyanamide is increasing and there appears to be a tendency to use more mixed fertilisers.

Little change is recorded in the use of superphosphate and basic slag, but there is a marked decrease in that of ground mineral phosphates. Information about potash is indefinite, although it seems that the committee's earlier recommendation for the increased employment of high-grade salts is being carried out. This is resulting in a decrease in freight costs per unit of potash. However, there is also a slight increase in the quantity of the lowest grade of manure salts used.

Changes in consumption are undoubtedly linked with the price increases which have taken place since 1949-50. The cost of nitrogen has gone up about 20%. That of phosphatic fertilisers has risen 35%. These figures, of course, are the average for all countries concerned. Wide variations have been noted in individual cases.

Changes in the cost of potassic fertilisers vary from decreases of 34% of the 1949-50 prices in Portugal to increases of 40% in France. Certain increases are due to the discontinuation or reduction of subsidies.

The reaction of the farmer to the steeply rising costs of fertilisers is bound to be unfavourable. It is therefore more than ever necessary to convince the farmer that the returns in crop yields that he obtains from the use of fertilisers will repay him, even at the higher prices; in fact, that to reduce his fertiliser consumption will be a false economy. Many farmers may find it difficult to finance the higher cost of fertilisers, particularly at a time when there is a tendency to restrict credit facilities. Advice, however good and convincing, must be backed with economic conditions, such as guaranteed outlets for his products, that instil the farmer with confidence. The relation between fertiliser prices and the prices of agricultural products is a vital factor, and unless the farmer can be assured of a favourable return for his crops he will incline to economise on fertilisers.

More and cheaper oils and fats

WE have become so used to discussing shortages of materials that it is a pleasure to be able to record the end of one shortage, that of oils and fats. The way prices have tumbled during the past nine months is one indication of the gradual increase in supplies. Some striking examples are given in the Unilever annual report. Whale oil, for instance, has declined from last year's peak price of £175/ton to £80 as of April last, palm oil (Congo) from £207 to £72, tallow (New York) from £146 to £40, and cotton oil (New York) from £213 to £98.

The story was given in much greater detail by Mr. J. C. A. Faure, Unilever's chief oils and fats buyer, at the International Association of Seed Crushers Congress held in Copenhagen in June. He stated unhesitatingly that the world scarcity of oils and fats is past. In 1951 world production was 23,410,000 tons, 240,000 tons more than he estimated in a similar review last year. In 1952 world production is estimated at 24,300,000 tons, a *per capita* supply of 21.9 lb. This is still 0.4 lb. below the pre-war supply and, in fact, because of the increase in world population total supplies would have to be increased by another 500,000 tons to restore the pre-war *per capita* level. However, if we take into account that stocks in Europe increased during 1951 by 600,000 tons, that stocks in the U.S. are also at a high level and, finally, that synthetic detergents have probably replaced oils and fats to the extent of about 400,000 tons, then it is valid to assume that total supplies available this year are actually likely to be in excess of the pre-war *per capita* level.

However, the enormous increase in world production of oils and fats since the war is by no means equally distributed over the whole range of commodities, nor over all areas. The U.S. is producing large quantities of liquid vegetable oils of which Europe is still short. (Nevertheless, owing to the likelihood of a total surplus of oils and fats in Europe this year of 839,000 tons, there should be no need for dollar imports in 1952.) Europe is still short of groundnuts, however, and this is reflected in the price. Furthermore, outside the U.S. there is a serious shortage of linseed and the drying oil industries have turned to soya and fish oils as substitutes.

These oils, therefore, are likely to remain dear but, according to Mr. Faure, other oils, such as U.S. cotton and soya oils, should be relatively very cheap. With this in mind he is of the opinion that there can be no excuse for

a return to prices five to eight times above pre-war level when expressed in sterling. Indeed, he states that if it were not for the reduced purchasing power of the pound, prices should revert to pre-war levels. Since the pound now buys much less, however, he thinks that prices should be between three and four times the pre-war level, taking the average of the period 1934-38 as the basis.

Cheaper and more plentiful supplies of oils and fats will affect the prices of many chemicals and consumer goods, and it is hoped that there will be a long period of stability so that the full benefits can be obtained.

Forest policy and native administrations

PROFESSOR E. P. STEBBING has some rather drastic comments to make in a recent issue of *Nature* on the attempts of certain administrations to induce native authorities to assume responsibility for forestry work, his remarks being prompted by the recent report on the work of the Forest Department in the Uganda protectorate.

The devolution of forest work in this manner was first embarked upon some years ago and in 1950 it was further extended. Professor Stebbing points out that similar action was taken a number of years ago in the Madras Presidency in India, which was then under British administration. The result was that a large area of forest was destroyed with the disastrous effects of increased erosion and decreased water supplies. The Forest Department has now been called in by the Indian Government to try to rectify the damage to forests which 30 years ago were efficiently managed under the Forest Department.

In Uganda, it would appear, it is envisaged that local administrations will take over all minor forestry operations in the areas under their jurisdiction, including management of minor reserves, supervision of village forests and the making of plantations of rapidly growing softwoods for the supply of timber and fuel.

It is apparently a prior condition that the local administration shall have adequate competence to undertake these additional duties, but the report itself admits that no local administration as yet possesses that competency. Under these conditions it seems most unwise to envisage such handing over.

As Professor Stebbing remarks, 'the continuance and, if possible, improvement of certain types of scrub forest in hot countries is essential to the wellbeing of local populations and their agriculture. Often it demands the highest knowledge and skill which is not possessed by the civil administration nor by village communities.'

It would appear to be yet one more example of the touching faith of British civil administrations overseas, and particularly in Britain itself, that the more jobs which can be handed over to native administrations without regard to their ability or competence to undertake them the better. One is irresistibly reminded of the amateur dramatic company who no matter how badly things go at rehearsal are fully persuaded that everything will be 'all right on the night.'

Farm mechanisation in Britain

DURING and since the war British farming has become the most highly mechanised in the world. The results of the Agricultural Machinery Census conducted during January 1952 and recently released by the English Ministry of Agriculture show that the process of mechanisation is still proceeding with little, if any, abated vigour. Concurrently the number of machines, implements and farm vehicles drawn by horses continues to show a continuing decline.

The previous census of this type related to conditions as at January 1, 1950, so that the difference between the two represents the change which has taken place during the past two years. We find, for example, that the number of tractors has increased by 24,000 or 9%, of trailers by 42,000 or 20%, of combine, fertiliser and seed drills by nearly 5,000 or 20%, while combine harvesters increased by over 60% to a total figure of 16,470. Concurrently, the number of horse-drawn ploughs and cultivators diminished respectively by 39,100 and 32,100 or 16% and 13%.

These are very striking figures and, although the rate of mechanisation naturally evinces some slowing down, it is still very considerable. The rate of replacement of horse-drawn implements by tractor-driven ones may, one supposes, be taken as an index of the rate at which the horse continues to be superseded by the tractor, and it is interesting that, being given the limitations of the tractor in certain directions, its replacement of the horse should apparently be continuing at an undiminished rate and without any obvious signs of slackening, notwithstanding the openly expressed fears of the Ministry that the process may have already proceeded beyond the bounds of prudence.

Rainmaking

AFRICA is a thirsty continent and very liable to be afflicted by drought. It is for this reason that the witch doctor in his role as a rainmaker has enjoyed such long and sustained power and influence over African tribes.

The artificial induction of rain by scientific methods has for some years past attracted the attention of meteorologists in America and also in Africa, and in these columns we commented on work in this connection some time ago. The latest developments are contained in a short article in *Nature* by Mr. D. A. Raynes, Director of the East African Meteorological Service, who reports the inception of experiments on rain induction at Kongwa by his department in collaboration with the Overseas Food Corporation.

Earlier work has been concerned with the use of silver iodide particles for seeding rain clouds; and the new experiments also involve the cloud seeding technique, making use of hydrogen-filled balloons. The principle is due to Mr. F. H. Ludlam, who suggested that hygroscopic particles might succeed in inducing rainfall from well-developed cumulus clouds which have not reached the freezing-point level. The theory is that such particles will result in the production in the cloud of water drops larger than those otherwise present, and that this will set up a chain reaction process and rain will be produced.

The seeding agent employed is a mixture of 90% sea salt and 10% calcium chloride, ground to particle sizes between 5μ and 100μ and averaging 50μ. The powder is conveyed into the cloud by hydrogen-filled balloons, special precautions being taken to keep the mixture dry. Dispersal in the cloud is achieved by exploding a small charge of gunpowder by means of a time fuse. In this technique the role of the explosive is merely to disperse the seeding agent; with silver iodide, however, the explosion plays an essential part in the actual production of silver iodide particles. The experiments are planned to cover a period of about four months and include comparison with the silver iodide method.

Control over chemical additives

NO one is likely to be so naive as to suppose that chemicals should be used in food processing or food production without some degree of state control. Legislation there must be—to protect the public against injurious additives and, as is the case with fertilisers, from substitutions or inflated declarations. In practically every country there have long been laws directly affecting trade in food and agricultural chemicals. The constant problem in this field is to determine the proper amount of control. It must be tight enough to ensure safety of public health, but should it become over-restrictive, progress in the development of chemical preservatives or pesticides must be retarded. Somewhere a balance must be struck. Yet the balance that may have been adequate in, say, 1939-40 may be quite inadequate by 1952; this, indeed, is what many people believe is a result of the intensive post-war development of so many new synthetic chemicals.

The Delaney Committee in the United States has recently been grappling with this problem. The hearing attracted exceptional attention; not unnaturally some of the more violent anti-chemical testimonies were treated sensationally in the Press—it is always ' news ' when somebody declares that a population is being mass-poisoned. Fortunately the reports of the Delaney Committee have the sobriety to be expected of official documents. Fertilisers have been given a clean bill of health. The extremist anti-fertiliser case, pressed hard though it was during the hearings, was completely dismissed. But pesticides are treated somewhat differently. These are classed with the chemicals added to foodstuffs in processing or packaging and it is considered that within this class ' no chemical should be permitted entry into the nation's food supply until its safety has been demonstrated beyond reasonable doubt.' The setting-up of an independent body to adjudicate on chemical additives is urged, to which evidence demonstrating safety must be submitted and, if it is considered satisfactory, permission for use will be granted. The major implication is, of course, that the onus to prove safety is placed upon the manufacturer of the chemical.

A minority report sought to distinguish between chemicals ' added to food ' before and after harvesting, thus excluding pesticides from these new controls, since it was felt that progress in pesticides and consequently progress in increasing food production would be handicapped by the additional legislation required if the report is accepted. It is difficult, however, to support this view, for the majority report has dealt fairly and objectively with a difficult problem. Thus, it observes, ' The committee does not believe that an insecticide which can be used without danger to the consuming public, and with benefit to the grower, should be kept from the market because of the failure of a few to observe the recommended directions for use.' This is not alarmism but good sense. It seems unlikely, therefore, that the recommendations, will in fact handicap the development of any really useful pesticide.

Fertilisers and health

ONE of the cardinal points of the anti-fertiliser creed is that the use of chemical or mineral fertilisers has led to an increase in human diseases. The evidence for this opinion is very slim. By a typical *non-sequitur* piece of reasoning, the Nature-or-nothing school points to the rising incidence of heart disease and cancer and also to the rising use of fertilisers, and claims that there must be a cause-and-effect relationship. It could as well be argued that the increasing use of the motor-car or aeroplane, with the resultant increase in air pollution by the products of petrol combustion, has caused these diseases to take a larger toll of human life. It is possible that cancer and heart diseases only *appear* to be on the increase because modern diagnostic methods are capable of revealing them, whereas 50 years ago they would not be detected and eventually the cause of death would be attributed to ' heart failure ' or something equally ambiguous. If, however, they can be proved to be more prevalent, then this may be because the lengthening span of human life creates a larger number of people whose age makes them susceptible to these diseases.

However, even when a relationship between fertiliser use and the incidence of these two diseases is seriously examined, the facts that emerge are quite contrary to the anti-fertiliser school's contentions. Malcolm McVickar of the National Fertiliser Association (U.S.A.) has recently compared the death rates from heart disease and cancer with the fertiliser use rates of various states in America. It has been found that where fertilisers are most used, the death rates from these two diseases are in fact lowest. Thus, in North Carolina, the most heavily fertiliser-using state, the death rates per 100,000 of population are 183.5 from heart disease and 69.3 from cancer or malignant tumours; in Virginia, which ranks eighth for fertiliser use, the respective rates are 249.1 and 29.7. For Georgia and South Carolina, which rank second and fourth in rate of fertiliser consumption, the death-rate figures are closely similar to those for North Carolina. For the United States as a whole, which involves bringing in vast areas that use little or no fertiliser, the death rates are 306.8 (heart disease) and 130.1 (cancer). This does not imply that there is in fact a connection between fertiliser use and the incidence of these diseases; there may be various other influences at work, notably the fact that country life is less likely to produce hypertensive breakdown of the heart than city life. It does show, however, that the detailed facts underlying the anti-fertiliser school's argument are actually pointing in exactly the other direction.

The Mechanics of Spraying

S. J. ZIMMER

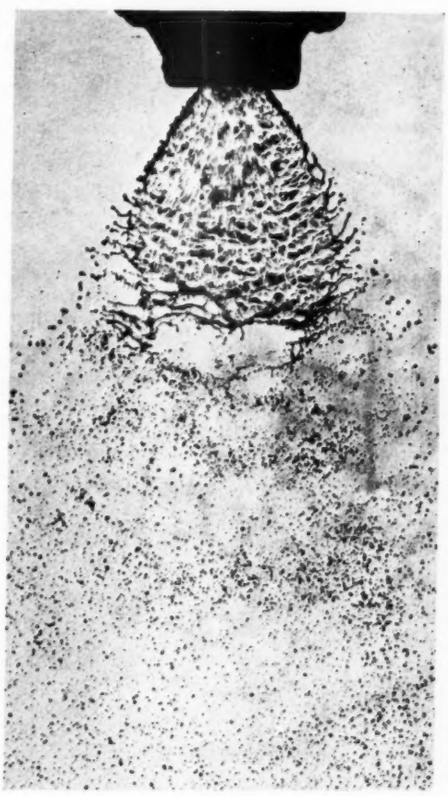
The development of new methods and techniques of applying insecticides and fungicides by spraying, automatically entails the study of the factors involved and the devising of new methods of determining their efficacy and efficiency. Some aspects of these problems are discussed and described below.

WHEN the natural, ecological and biological factors which limit and control the spread of plant pests and diseases fail to be effective, recourse has to be made to spraying and dusting with chemicals. The factors which underlie the control of pests and diseases by chemical methods fall under three headings: (*a*) the chemistry of the poison and its relationship to pest and host; (*b*) the biology of the pest and host; and (*c*) the physical aspects of the problem. Broadly, the third of these is mostly concerned with determining the dosage rate for each set of conditions as well and as cheaply as possible, and on this account is particularly the concern of the practical grower. Moreover, just as the spray engineer must take account of the biological aspects, so the biologist must also consider the adequacy of the machinery with which he is working.

Dosage and application

The required dose of any chemical varies according to the pest, the host plant and the chemical itself. The application methods employed vary equally widely, and also depend on the weather and the type and size of the plantation. In the first place the chemist develops a poison for a particular pest. Secondly the biologist examines the biological consequences of its use on the plants themselves, on the pests and on their predators and parasites, as well as on other creatures liable to be affected by the spraying. He must also specify how, when and where the poison is to be used. The engineer must then attempt to develop methods of putting the biologist's requirements into practice. This threefold sequence does not, of course, necessarily imply a strict chronological order. Known pests stimulate the search for new chemicals; new methods of application have been developed which are so valuable that the biologist searches for ways in which a particular machine can give him the control he requires, while the chemist seeks materials suitable for use with the machine.

In this article we shall consider the problems of ascertaining how to apply the proper dose of chemical at the right time and place. Methods of measuring dosage form an important part of the work of the biologist to enable him to find out the form and the magnitude of the dose required to control the pest and also to assess the machine's performance. The work also entails study of the fundamental physical factors involved in spraying and dusting in order to determine the necessary dosage. It is further concerned with the practical engineering aspect of applying the materials and particularly in the form of low-volume sprays.



A short exposure photograph of a fan nozzle in operation showing the mode of break-up and how the drop size varies in different parts of the sheet of liquid

Approaching the problem

The basis of approach to the problem lies in finding means for measuring the amount of deposit of a spray on a target in contra distinction to the more obvious and usual method of estimating dosage rate by emptying the tank and assuming that the contents have been well and equally spread over the sprayed area.

Measuring the macrodose

To measure the macrodose—that is the dose per plant, per leaf or per unit of area—it is customary to spray with a material which can be readily detected. Either leaves, plants or special sampling surfaces are selected to be representative of the overall result.

Chemical analysis of the dose is out of the question for most work, since it may at times be necessary to treat separately about a gross of samples before the results are reliable. The method most commonly used is to add a tracer dye to the spray and estimate the dye deposit colourmetrically—usually with one of several available absorptiometers. A team of three can deal with a gross of samples of glass plates, for example, in four hours.

When leaves themselves are used it is necessary to measure their area to obtain the dose per unit area, and this is most readily done with a photoelectric area estimator. When the average of a bulked sample of many leaves provides sufficient information, however, a quicker estimate of the area in total can be obtained by calibration from their weight when dry. The calibration graph, area against dry weight, is not quite linear but is approximately independent of growing conditions and even leaf maturity.

Microanalysis of the deposit

The microanalysis of the deposit—its ultimate formation from individual drops—is of equal importance. Qualitative estimates should be made of dosage rate, number of drops per square centimetre, area actually covered by spray deposit, the relative frequency of occurrence of different sized drops and, in particular, the occurrence of large drops which are wasteful of material and also liable to cause damage. Leaves themselves can be used, provided a spray or tracer is available, suitable for preparing an easily visible representation of the deposit. Thus copper can be made prominent by using papers sensitised with rubeanic acid, and some forms of sulphur by using a lead nitrate developer. It is usually more convenient, however, to use an artificial sampling

surface; for some purposes this should represent a leaf, but more usually it is assumed that an entirely dissimilar surface receives a dose which is related to that received on a leaf.

Qualitative measurements of the macro-dose are of only limited value and it is now considered necessary to obtain more exact evidence of how the spray is distributed. Suitable surfaces for different purposes are specially standardised blotting paper or a good filter paper or a glass slide coated with a freshly prepared film of magnesium oxide; alternatively an absolute method is to collect the spray in a liquid of similar density which is immiscible with it and of suitable viscosity to hold the droplets immobile. Large—a foot square—sheets of filter paper provide an adequate measure of the dose on a horizontal surface and are suitable for making drift spraying experiments on crops not more than a few inches tall. Their limitations are that the maximum dose which can be recorded is only a few gallons per acre and the minimum drop size is rather greater than 50 microns. Although their use is restricted, they provide, however, a good method of measuring ground dosage. For leaf dosage artificial leaves of plastic on a suitable stalk, magnesium - oxide - coated plates and bare glass plates are used, depending upon the facilities available and type of answer required from the experiment.

Difficulties of measurement by eye

Quantitative measurements of the macro-deposit by eye are tedious and laborious. Furthermore, until the development of small or very small volume (less than one gallon per acre) spraying, they have been of only minor importance and have only rarely been made in entomological or other spraying experiments.

In any case it was early realised that quantitative measurements by eye are a major obstacle to progress, since staff usually prefer to change their employers rather than do the work of counting and sizing the drops.

Accordingly a machine has been built to do the job. This machine can determine in a matter of minutes how many drops there are in each of ten size ranges and in the total dose, the area of sampling surface covered by the deposit, the size of the largest drops and the numerical drop density. The machine can also count and size in other particulate systems, notably dusts and insects.

A large part of the work of assessing the value of spraying machines accordingly involves frequent measurements and new techniques will have to be developed to meet new assessment problems as they arise.

Physical and biological methods

Physical measurements permit a check of spraying efficiency without considering the pest involved, and provide results more quickly and more accurately than old biological methods, although, of course, the correlation between the two must be checked frequently. They are the most important preliminary measurements for estimating the performance of a new machine or of the efficiency of a new technique.

Machinery and techniques

Machinery and techniques form the remaining part of the engineer's programme of work. They involve fundamental problems, a large amount of empirical work and subsequently practical field trials and extended consumer usage trials. The remainder of this article will consider briefly the more academic aspects of the subject and their practical importance.

Drop size

It may be assumed that, when using a small volume of concentrated material to dose a large area, only small drops are needed. How small they will need to be for a particular purpose depends upon a number of factors. The tendency is, however, to use drops which are so small as to be very susceptible to air movement. They are near aerosols and may lie anywhere in the range 10 to 500 microns in diameter. One micron is a ten-thousandth of a centimetre and a 100-micron drop is about the thickness of a hair.

Nozzles

The large drops are usually formed by three kinds of nozzle called anvil, swirl and fan types. The functions of them all are similar fundamentally in that the liquid leaves the nozzles in the form of a thin sheet from which small drops will form—they cannot be formed from a cylindrical jet so easily or well.

Anvil nozzles are commonly used where a low working pressure is needed. Then a rod of liquid is directed against the anvil which is usually a solid plate of suitable form but may be an opposing stream of liquid. The momentum of the stream along a line drawn at right-angles to the surface of the anvil is destroyed and the rod becomes a sheet travelling in another direction.

Fan nozzles are a development of this whereby the convergence of the final orifice channel directs the stream of liquid and forces it to leave an oval slot in the form of a fan-shaped sheet.

Swirl nozzles are a little more complicated in that two orifices are needed. The first, called the swirl plate, has spiral grooves or channels cut in it which cause the liquid to rotate, and on leaving the final orifice the rotation of the liquid causes it to diverge in the form of a conical film.

Once a diverging film is formed, the break up into drops follows automatically. Waves are formed on the sheet surface and are so built up by air friction that as the sheet becomes thinner it eventually breaks, giving an approximately rod-like ligament which breaks into drops along its length in a manner controlled mainly by the liquid surface tension. Surface-active agents seem relatively powerless to affect the break up because, it is presumed, the time taken to break up is too small for them to reach the new surfaces before the process has been completed.

The size of drop formed from a well-designed nozzle is determined mainly by the nozzle capacity and the pressure used. Variations caused by a change in the physical properties of the liquids used are small for most spray materials.

Dosage and drop size

Since an acre of land may carry a crop with a leaf area of 10 acres, a low-volume spray of 10 gal. per acre of ground is spread at the dosage rate of 1 gal. per acre of leaf surface, *i.e.* about 100 micrograms per sq. cm. One drop 600 microns in diameter weighs approximately 100 micrograms. Therefore the dose on a square centimetre could be one 600-micron drop or two hundred 100-micron drops for a dosage rate of 10 gal. to the acre. Using the smaller drops the intervals between the drop centres would be about 700 microns and for a spread factor of three about 20% of the leaf area would be covered with spray material.

Accordingly for such work a very finely dispersed spray is required, while it is also necessary to work under atmospheric conditions which favour the deposition of these very small droplets. An air blast nozzle, which is similar to a scent spray nozzle, is used to obtain this fine atomisation. An air speed of about 160 m.p.h. will give drop sizes comparable with that obtained from a small-volume nozzle (Fanjet D60, Teejet 8001 or Bray 000).

High air speed

Air speeds greater than this are most cheaply obtained with a compressor. This generates the 300- or 400-m.p.h. blast to

The eventual aim is often a new type of spraying machine like this commercially developed fog sprayer

atomise the liquid stream and the spray is then picked up by the main slower moving airstream. Where it is very necessary to avoid any drift it is customary to use a nozzle made from discs of stainless metal which rotate at high speed. The liquid is fed axially to the discs which throw it off under centrifugal force in drops which are very nearly all the same size. The variation is only a few per cent. from the mean. A spray composed entirely of particles all of one size can be aimed with moderate certainty that it will land within prescribed limits.

Aerosols

On occasions even smaller drops than can be obtained either with an air blast nozzle or with a spinning disc are needed. Such small drops, less than about 30 microns, are so very nearly airborne that they are called aerosols, *i.e.* air solutions. They act almost like a gas and are invaluable for fumigating enclosed spaces. The outdoor uses of aerosols are largely confined to periods of either dead calm or of a strong inversion of atmospheric temperature. This means in effect that the aerosols give their best performance a few hours before sunrise, when dusting is also best done.

Aerosols are most readily generated by spraying a dilute solution of a toxic agent in a volatile solvent. When the solvent evaporates a residual drop, smaller in proportion to its dilution, remains. Alternatively, drops in this size range are formed by volatilising the substance and permitting condensation and coagulation to a controlled extent. Such thermally generated aerosols have the disadvantage that the material must be capable of being evaporated or sublimated at atmospheric pressure without decomposition. This limits the usefulness of thermal fog generators considerably.

In passing it is important to note that even in a temperate climate all small-volume sprays are susceptible to losses by evaporation. It is often necessary to minimise this by preparing the solution in an oil of suitably high boiling point.

Nozzle requirements

Finally, nozzles of all types must be fitted to spraying machines suitable for working in a given crop under prescribed conditions and capable of providing the dose required by the biologist cheaply and quickly. Several empirical approaches have been made in commercial machines using spinning discs, airblast nozzles or swirl or fan nozzles.

Much, however, remains to be done to ascertain their potentialities, either by watching their biological results or, preferably, by measuring their physical performance, predicting a probable biological performance and checking on the latter when all obvious improvements suggested by the physical results have been made.

Photos: National Institute of Agricultural Engineering.

Widening Application of Insecticidal Smokes

Promising results against moths and beetles attacking tobacco are reported to have been obtained with DDT/Lindane insecticidal smokes made by the Fumite Division of WAECO Ltd., and believed to be the only smoke of its kind at present on the world market. Research is also being carried out in various parts of the world against insect pests attacking standing crops such as wheat, oats, paddy rice and against species of caterpillars which attack and defoliate palm trees, etc.

Lindane, being the pure, odourless gamma isomer of BHC, is non-tainting—important where soft fruits are concerned. Insect pests which tend to resist DDT are killed by Lindane and very few resist the two.

In the past Fumite insecticidal smoke has only been concerned with the destruction and prevention of insect pests in food products stored in granaries, mills, maltings, warehouses, etc., and in settlements, hutments and bungalows against mosquitoes, flies, moths, termites, etc.; also against wood-boring beetles which attack timbers. Messrs. WAECO Ltd. now report that, as a result of extensive research, the use of smokes against pests attacking crops in the fields is promising.

Dieldrin Accepted for Control of Plum Curculio

The United States Department of Agriculture has accepted for registration dieldrin for control of first brood plum curculio on peaches. Experiments conducted in several peach-growing states have proved that plum curculio damage to peaches is sharply reduced as a result of early-season applications of dieldrin.

In making the announcement, Mr. F. W. Hatch, Manager, Agricultural Products Department, Shell Chemical Corporation, said that peach growers could economically control plum curculio without endangering the quality of the crop.

In experiments conducted in small-plot and large-plot orchards at Fort Valley, Georgia, dieldrin proved superior to other materials for controlling plum curculio. Dieldrin did not affect the flavour of the fresh ripe peach, nor was any phytotoxicity observed on any part of the peach tree.

The plum curculio damages peaches by puncturing the fruit for feeding and egg-laying. Later, its larvae tunnel through the fruit, feeding on the pulp. Infested fruits generally drop to the ground; plum curculio attacks also promote the spread of brown rot on peaches.

The Use of the Low-Volume Mist Blower

J. M. BESKINE, B.Sc. (Eng.), A.M.I.B.A.E.

In the following article the practices of drift spraying for field and some plantation crops and blast spraying for orchards are described and discussed. The low volume mist blower is a comparative newcomer to agriculture and in this article our contributor covers some of the aspects of this method of applying agricultural chemicals.

DURING the last two years a new type of low-volume sprayer has appeared on the market, the low-volume mist blower, accompanied by optimistic claims regarding its performance under field conditions.

Soundly designed machines of this type are undoubtedly a good investment, but there have been cases of badly constructed and incorrectly designed machines which have threatened to discredit a major advance in sprayer design and to delay the adoption of improved spraying technique.

The correctly designed low-volume mist blower has come to stay; for many purposes it is likely to replace other types of ground machines, while for certain purposes it will be a strong competitor to aircraft and may replace them to some extent.

Both the manufacturer and the user will therefore be interested in a survey of low-volume mist blower technique and a summary of the performance to be expected from a satisfactorily designed and properly used machine.

The modern low-volume mist blower

The modern low-volume mist blower must be distinguished from the older high-volume blast sprayer, the aerosol applicator and various row-crop low-volume sprayers which incorporate, to a certain extent, the mist blower idea; nor must it be confused with power dusters, in spite of a certain superficial resemblance in function. The low-volume mist blower does not make use of aerosols or indeed of droplets smaller than about 50 microns in size.* Research work is still proceeding to discover the best working range for droplet size, but it can be accepted that nothing smaller than 50 microns and very little, if anything, larger than 200 microns is likely to prove satisfactory for application in the open air.

The characteristics of a modern low-volume mist blower can be defined as follows:

(1) It should convert a solution, suspension or emulsion of pesticide into droplets and disperse these so as to enable effective drift spraying or blast spraying to be carried out.

(2) The same machine should be capable of being used as a drift sprayer or a blast sprayer as required.

* One micron equals one ten thousandth part of a centimetre, i.e. it corresponds to about 1/25,000 inch.

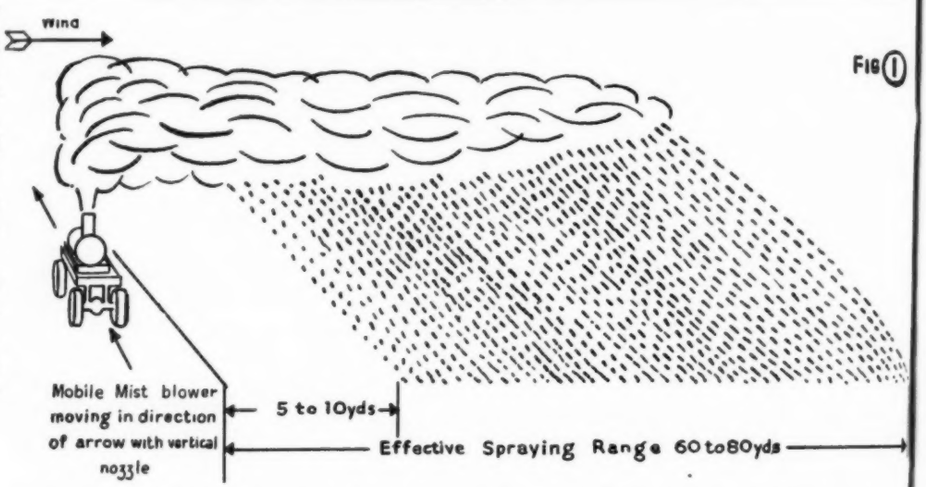

Wind
Mobile Mist blower moving in direction of arrow with vertical nozzle
5 to 10yds
Effective Spraying Range 60 to 80yds

FIG (1)

Use of a mist blower as a drift sprayer for open field and plantation crops

(3) The design of the nozzle and fan, etc., should enable the mean size of droplets to be varied at will.

(4) The machine must ensure that the droplets are effectively deposited on the target area.

(5) The design of the machine must enable it to be driven by the smallest engine practicable and the fuel and other running costs to be kept down to a minimum.

Experience has shown that a properly designed and used machine can reduce the water requirement during spraying by 90% and the labour requirements by 80%. There is no loss from nozzle drip and effective placement of the bulk of the material discharged can enable a saving of as much as 25% in chemicals consumed.

Of the two methods of using a low-volume mist blower, drift spraying is adopted for open crops and blast spraying when a concentrated effect is required. Drift spraying is used for killing locust hoppers, spraying cotton and tea and in general wherever protective action depends on the delivery of a pesticide from overhead. It should be noted that, although there are certain resemblances between drift spraying from aircraft and ground-based mist blowers, the spraying technique in the latter case is quite distinct and must be studied separately. Blast spraying is used in orchards and plantations of an orchard-like nature. It is used for fruit trees and bushes, hop bines and plantation crops such as coffee, cocoa and rubber.

Technique of drift spraying

Drift spraying is carried out in two ways: (*a*) with the nozzle of the mist blower in a vertical position and (*b*) with the nozzle inclined in the direction of the target area. For most purposes the nozzle must be held vertically. It is only held at an angle to surmount obstacles and when spraying is being carried out on sloping ground, *e.g.* as in hillside tea gardens.

For open crops, where there are no obstacles, by keeping the nozzle in a vertical position and getting the spray as high into the air as possible, the wind carries the droplets horizontally towards the target area and, if they are not too small, they fall to earth where pesticide application is desired. With a vertical nozzle and a suitable wind, extremely satisfactory uniformity of distribution of the pesticide solution can be obtained.

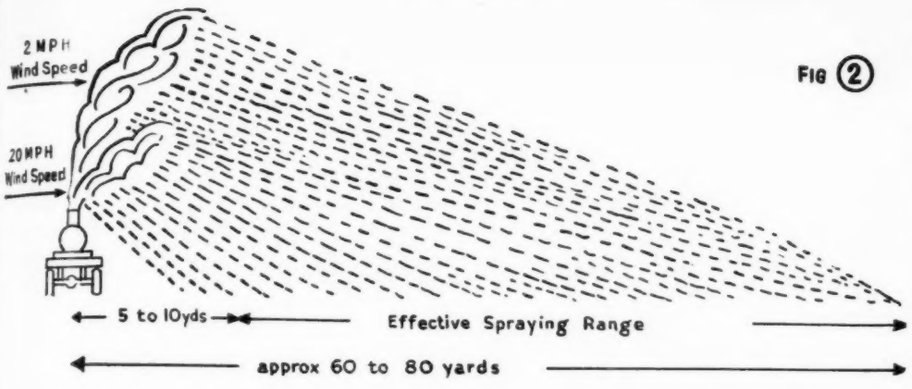


FIG (2)

For wind speeds between approx. 2 and 20 m.p.h. the effective spraying range is practically constant. In the diagram, cloud plume heights are exaggerated to show tendency

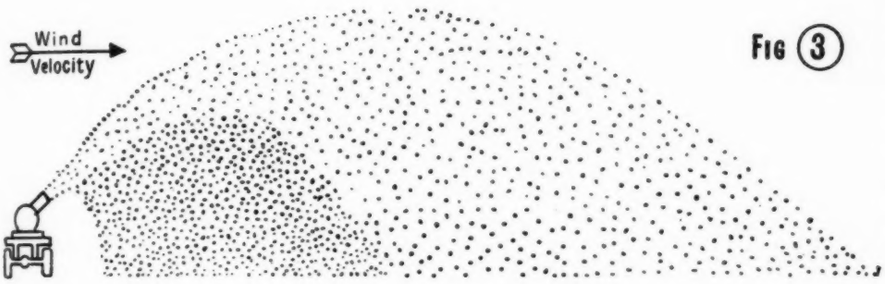


FIG (3)

The nozzle of a mist blower should not normally be inclined in the direction of the target area, because some droplets will not then have enough vertical velocity to carry them any great distance from the blower

Fig. 1 shows a low-volume mist blower being used for drift spraying of a crop such as cereals, roots or cotton. The drift cloud is carried downwind as shown and, irrespective of the wind velocity, as long as it is between about 2 m.p.h. and 20 m.p.h., the swathe width remains constant at about 60 to 80 yds. Experiments have shown that fairly large droplets are necessary to avoid dispersal and loss of material. Clouds composed of droplets as large as 50 to 100 microns may at times fail to settle, even at crop level, because of eddy currents which cause them to be blown about and dispersed over a large area. If smaller particles are employed, say from 5 to 10 microns, although the coverage may appear very thorough it is really quite ineffective. For example, one mist blower produced a smoke-like mist cloud which drifted for a considerable distance and appeared to envelop plants most thoroughly, but when checks were made it was discovered that very little pesticide had been deposited owing to the droplets being so small that they drifted on and on without settling at all.

There is, in fact, only one way of assessing the effectiveness of a mist blower's performance, and that is by checking the deposit actually made. For insect destruction on most open crops, droplets of about 100 to 150 microns at a rate of application of about one gallon per acre appear to be most satisfactory. For fungus control, however, a greater amount of spray liquid is necessary and the concentration of fungicide should be somewhat lighter. For many fungi, 50 to 100 micron particles are effective at concentrations of only a few gallons per acre, providing they can be got down to crop level.

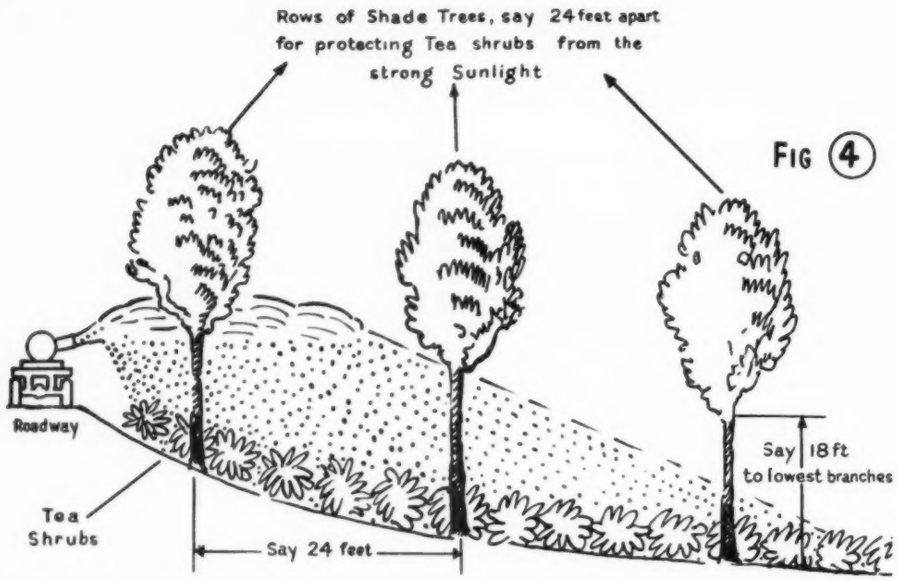
Droplet distribution

If there is no wind and no suitable convection currents, drift spraying is out of the question with a ground-based machine and it is a waste of time, chemicals, fuel and labour to attempt it.

In practice there is nearly always sufficient wind to enable effective drift spraying, providing the right time of the day is chosen for the work, there is a wind speed of between 2 m.p.h. and 20 m.p.h. and there are no serious upward air currents or ground undulations cutting across the target area. With the nozzle set vertically a plume of cloud or mist will appear to form above it and as the wind speed decreases the cloud increases in height, being very long and vertical for no wind at all, fairly long and curved forward in the direction of the wind for about 2 to 3 m.p.h. winds, and shorter and more steeply inclined for higher wind speeds. The cloud plume is not necessarily entirely visible, since visibility depends partly upon atmospheric conditions and partly upon the droplet sizes. At wind speeds below 2 m.p.h. and when there is no wind at all the spray tends to drop back to earth in the vicinity of the machine. At wind speeds greater than 20 m.p.h. the tendency is for the drifting spray to get out of control and for a large proportion of the droplets to be dispersed and miss the target area.

An airborne droplet is under the influence of two velocities, one due to wind and air currents, and the other due to gravitation. If it is too small and light it will be carried away before it has had time to sink to crop level. If it is too heavy, it will fall to earth near the machine. When a particle commences to fall to earth in the cloud plume, it tends to move in a straight line; if spraying conditions are correct the greater the wind speed the less steep will be the angle of inclination at which it moves. The net result is shown in Fig. 2. The combination of wind speed variations and cloud plume height, as well as different fall velocities, causes the droplets to tend to move in approximate straight lines and to fall to earth within an effective spraying range of 60 to 80 yds. Droplet distribution is fairly uniform within this area, and for this reason the area indicated in Figs. 1 and 2 is best taken as the standard drift spraying target. The width of the target area depends upon the shape of the field. The mist blower is moved in a direction at right-angles to the wind and when one swathe is completed the mist blower is turned round and continues along the next swathe. The important fact is that the effective spraying range is sensibly constant, and this has a great bearing upon the economics of drift spraying by ground machines.

If attempts are made to obtain great swathe lengths by using high wind speeds, excessively light droplets, etc., it is practically certain that coverage will be ineffective. If the nozzle is inclined in the direction of the target area (see Fig. 3) there will be an excessive deposit in the vicinity of the blower, since many of the droplets will not have been given sufficient vertical height to enable them to travel sufficiently far in a forward direction before dropping to earth. On inclined ground and where there are obstacles to avoid, inclining the nozzle enables fairly adequate and uniform coverage to be obtained (see Fig. 4 overleaf).


Rows of Shade Trees, say 24 feet apart for protecting Tea shrubs from the strong Sunlight
FIG 4
Roadway
Tea Shrubs
Say 24 feet
Say 18 ft to lowest branches

Where obstacles must be avoided, as in tea gardens, it may be necessary to incline the mist blower nozzle

Hillside work

The technique shown in Fig. 4 is used on hillside plantations and where there are obstacles to overcome. It is somewhat different to the open-field drift-spraying technique, since the nozzle is inclined in the direction of the target area, and complicated considerations of ground slope, obstacles and air currents have to be taken into account. The beam of spray must be directed so as to avoid obstacles, tree branches, etc. The dimensions given in Fig. 4 are typical of tea garden practice and, though the results may not be quite as effective as if drift spraying was being carried out on open ground, they will usually be far better than might be expected.

Difficulties with unfavourable air currents

If the right time of day is chosen, drift spraying is much more effective and economical. It may sometimes be necessary to carry out spraying at night or during the early morning in order to avoid excessive wind or undesirable convection currents. Night spraying is easily carried out with the aid of searchlights. Downward convection currents generally occur in the early morning and are worth taking advantage of, as they direct the droplets towards the ground (see Fig. 5). Later, as the day gets warmer, upward air currents tend to occur which cause droplets to drift upwards away from the target area. For this reason effective drift spraying in open fields and plantations cannot as a rule be carried out all day (see Fig. 6).

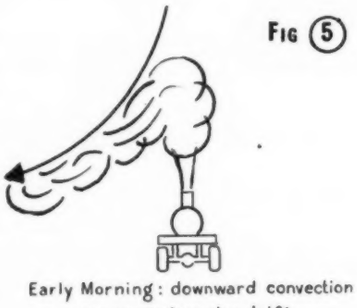
Machine design

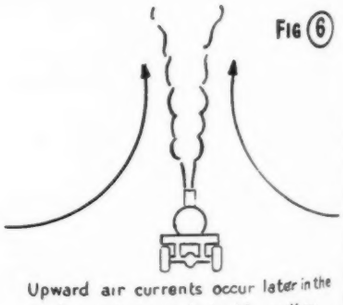
Economy of operation is bound up with machine design and methods of working, as well as with intelligence and skill of the operator. For example, if greater use could be made of lighter particles increased economy should be obtained, since weight for weight there are 27 times as many 50-micron particles as 150-micron particles. A much greater coverage is therefore possible if one could make use of the lighter droplets, but this can only be done if wind and ground conditions are very favourable. Fifty-micron droplets can be regarded as the lightest permissible in a normal type of mist blower; they are easily carried away by the wind and upward currents, while eddy currents due to ground undulations may disperse them. Actually eddy currents, especially at high wind speed, tend to disperse much heavier droplets and may even cause complete loss.

Of course, 150-micron particles are much heavier than 50-micron ones. They hit leaves and foliage more easily, have a greater momentum and can pierce the air cushion around vegetation without difficulty.* But only one-twenty-seventh the number of droplets of this size are produced compared with 50-micron droplets at the same concentration; moreover, while 150-micron droplets are effective enough for insects, they are too large for fungi. It is not possible to discuss this aspect in detail, but clearly the mist blower must produce the correct sized droplets and the entomologist must work hand in hand with the engineer and farmer.

Wind speeds higher than about 20 m.p.h. are unsuitable for drift spraying. There is nearly always sufficient ground unevenness to cause upward air currents at high wind speeds and, even in the case of perfectly flat target areas, excessive wind speeds prevent effective spraying and lead to dispersal of the droplets over too large an area. Another point is that, beyond a distance of about 60 to 80 yd. from the nozzle, droplets which have not fallen to earth or crop level tend to follow divergent paths. Beyond this distance drift spraying is not very satisfactory. Production of excessive amounts of small droplets or the use of extra engine power to heighten the cloud plume in an effort to lengthen the target area may be open to objection. Fig. 7 indicates what can be expected if a very long target area is aimed at. There will be effective coverage up to about 60 to 80 yds. providing the correct sized droplets are produced, but due to forward movement of the machine at right-angles to the wind, slight changes in wind speed and more particularly in wind direction may set up a slightly oscillating beam leaving the nozzle. Up to about 60 to 80 yds. deposits from this moving beam tend

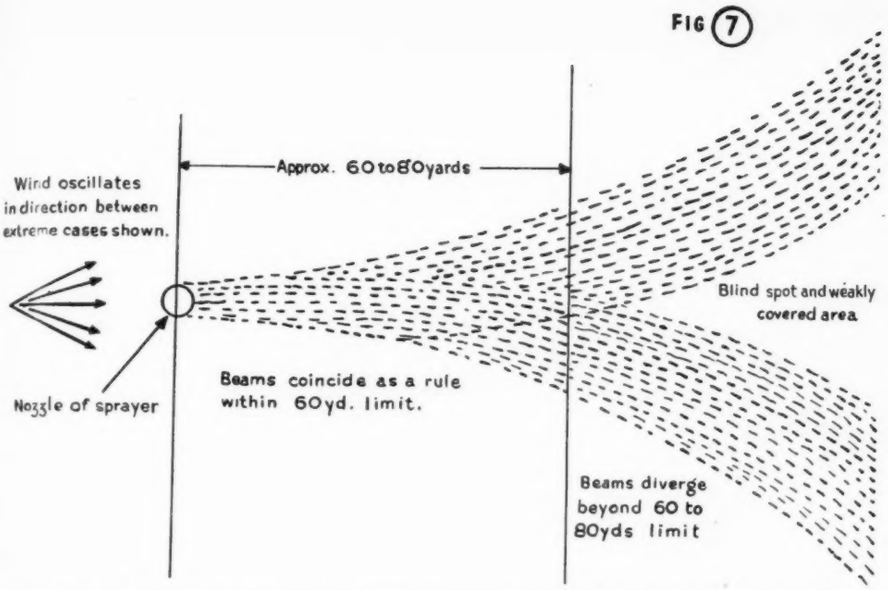
* This has a great bearing upon blast spraying and will be discussed later.





Choose the right time of day for carrying out drift spraying

FIG (7)


Approx. 60 to 80 yards
Wind oscillates in direction between extreme cases shown.
Blind spot and weakly covered area
Beams coincide as a rule within 60 yd. limit.
Nozzle of sprayer
Beams diverge beyond 60 to 80 yds limit

Plan view of oscillating beam and blind spots beyond 60 yd. limit (not to scale)

to overlap, but beyond this the effect may be the same as if two diverging beams were produced. Partial coverage beyond about 80 yds. would be possible, assuming the droplets get to earth, but there would be considerable blind spots and weakly-covered areas. If, on the other hand, one sets out deliberately to ensure that a large proportion of the deposit occurs at a point beyond the 60 to 80 yds. limit, there will be ineffective coverage and a considerable increase in fuel and chemical consumption.

Blast spraying for orchards and plantations

In the first part of this article it was pointed out that a modern well-designed machine should be capable of being used with success as a drift sprayer and as a blast sprayer. Now blast spraying technique will be discussed and some examples of special applications given both for blast operations and drift spraying.

Blast spraying

Drift spraying cannot be employed effectively when trees and bushes have to be dealt with, and blast spraying is the recommended method of application in orchards and on plantations of permanent tropical tree crops (see Fig. 8). Blast spraying differs from drift spraying inasmuch as it is carried out at close quarters and engine power is necessary to induce an air blast powerful enough to force the droplets into the heart of the foliage of the tree or bush being sprayed.

As in the case of drift spraying, if the machine is correctly designed and used, excessive engine power is not necessary and there need be very little wastage of water or of chemicals. It is, however, unfortunately true that some blast sprayers, designed for orchard work and not capable of drift spraying, are wasteful of fuel and chemicals because they are designed to 'saturate' the whole of the atmosphere around a tree or bush. This may appear very impressive to the uninitiated, but it is not, because an effective blast spraying can be obtained with a modest expenditure of fuel, a reasonably small engine and little wastage of chemicals.

Drift spraying is only suitable where a cloud of droplets carried along by the wind can fall to earth and impact upon vegetation requiring treatment. If it is necessary to deposit chemicals upon the underleaf surfaces of a crop, it may be necessary to use a type of field sprayer equipped with underleaf spraying nozzles. On the other hand, if a disease can be controlled by depositing chemical compounds on the top surfaces of the leaves or, if, for example, a secondary action occurs after initial deposition which enables the under-surfaces to be dealt with, then drift spraying becomes applicable and the cost of spraying can be reduced considerably. This, however, proves a problem to the specialist.

The spraying problem, in the case of tree and bush foliage, is different from that of field crops because it is necessary to penetrate the foliage and, as a rule, to deposit droplets of chemical solution or emulsion, etc., on both sides of the leaves, blossoms, etc., and generally throughout the whole of the foliage. In fact, intense application is required and this must be attained by horizontal or upwardly directed 'blast.'

It is not possible to make use of the wind or of gravity; large clouds of droplets in the vicinity of trees and bushes may appear to be blown on to the foliage, but on examination it will be found that much of the cloud has been lost and any deposition that may have occurred is on the outer parts of the tree or bush foliage only. If such a cloud consists of extra large and heavy droplets, a larger proportion penetrates, but in any case the greater part will fall to earth and be wasted.

For effective tree and bush spraying two conditions must be satisfied: (i) there must be sufficient momentum behind the droplets, which must in any case be of the right size; and (ii) the beam of droplets must be directed on to each part of the foliage in turn. 'Single shot' blast applications are likely to be wasteful and expensive, but this must not be taken to imply criticism of large high-volume blast sprayers, which are in a class apart. Such machines require large quantities of fluid for their operation and, moreover, need powerful engines. Nevertheless, for certain purposes they can be an economic proposition.

From a theoretical point of view it might be possible to devise an effective method of 'one shot' blast application. With a low-volume mist blower it would probably include using aerosols and locating applicators running up within the foliage of each tree, an expensive business which would be more costly still if external shrouds were also necessary, which is not unlikely. It is unlikely, however, that such a procedure would be economical.

If specialists and manufacturers could devise a method whereby spray solutions after deposition became capable of a secondary action and aerosols would again be given off locally, an entirely new range of possibilities would arise and drift spraying would become applicable to a much wider range of field crops, while blast spraying would be further simplified. Meanwhile, aerosols remain of value for confined spaces only, *e.g.* in greenhouses or where shrouds can be employed.

Importance of blast

For a mist blower to carry out effective blast spraying of trees and bushes it should be capable of producing a blast of droplets which can penetrate the outer cushion of air surrounding the foliage and penetrate within the foliage, displacing entrapped stagnant air. This entrapped air is a more serious obstacle than the outer air cushion. The mist blower, if correctly designed, will produce a blast which will penetrate each section of the foliage in turn. In this way engine power and fuel are not

wasted and maximum use is made of the forward velocity of the droplets to force them into the foliage.

One of the disadvantages of an unscientific approach to blast sprayer design is the danger of attempting to cover the whole of a tree in one unidirectional blast, as Fig. 9. It is hardly possible to maintain sufficient momentum throughout the beam and to do this in consequence the tendency is frequently either to attempt to overcome this difficulty by employing an unnecessarily large engine or to be satisfied with very indifferent results. It is true that the inside of the foliage can be reached in this manner, but only if an excessive amount of chemical is employed. In consequence there may be an appearance of effective spraying being carried out at high speed through an orchard or plantation and an impression of maximum mechanisation and minimum labour requirements—but in fact the results are often not as impressive as they appear to be at first sight.

Sometimes machines are employed for spraying both facing sides of parallel rows of trees at the same time (see Fig. 10). The difficulty here is to avoid serious wastage of chemicals, engine power and fuel, since all that is being done may be to disperse effort over too wide an area and to fail to penetrate the foliage effectively except in local areas.

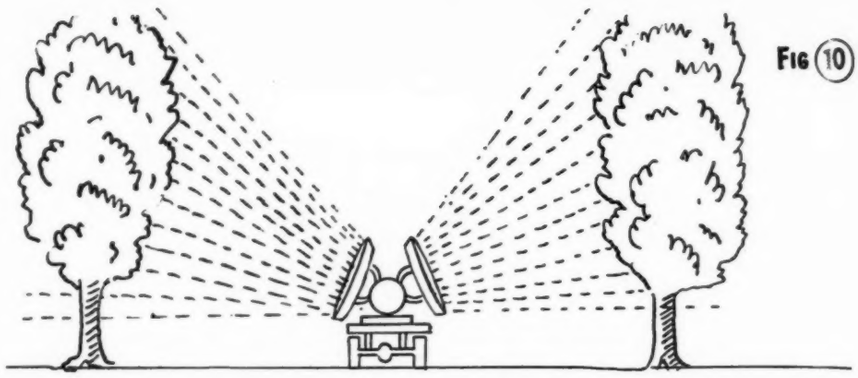


FIG (10)

It is very difficult to penetrate the whole of the foliage in one shot with facing trees

The Wageningen method

When blast application is being carried out with a mist blower it is necessary to avoid directing the beam from a point too close to the tree or bush. The cloud of mist must be formed between the nozzle of the machine and the target area. If you attempt to spray from too close quarters with a mist blower you will probably cover too small an area per 'shot' and in addition the forward velocity of the droplets will be excessive. The result would be wastage of chemicals, damage to the fruit, etc., and ineffective spraying. The great advantage of employing a properly designed mist blower for blast fruit tree and bush application is the possibility of obtaining reduced fuel consumption and of consuming less water and chemicals, as well as the ability to get a more effective coverage. But the correct method of application must be employed, and for this purpose it is recommended that use should be made of procedure developed by the Dutch research station at Wageningen. Examples are shown in Fig. 11.

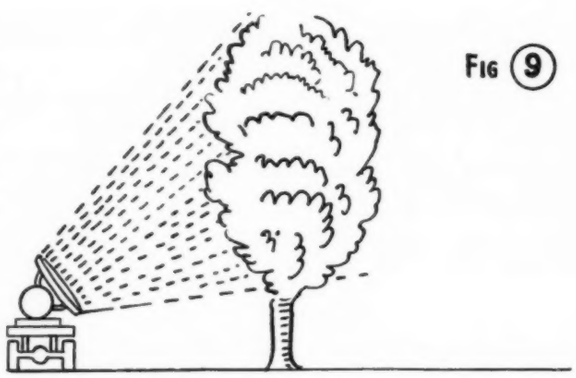


FIG (9)

Attempting to cover the whole of the tree in one unidirectional blast is ineffective because of incomplete penetration, excessive engine power and wastage of chemicals

In the Wageningen method the machine is moved between the trees at between 2 and 3 m.p.h., and the sprayer nozzle is moved slowly from side to side and upwards and downwards so as to penetrate into every part of the foliage on the facing sides of the trees. The mean distance of the nozzle from each tree, as it is being dealt with, is recommended as about 6 to 8 yds., and as soon as one tree is completely sprayed the machine nozzle is turned round to deal with the next tree on the opposite side. A point to watch for is to ensure that the machine nozzle is not moved or oscillated too quickly; the speed must be such that the air blast is maintained directly behind the beam. If this point is overlooked ineffective spraying and wastage of chemicals may result.

In the case of hops and bush fruit it is necessary to work as if two continuous walls were being sprayed, spraying the trees or bushes from side to side in order to cause effective overlap between subsequent 'shots.' The procedure with hop bines is to ensure that the machine nozzle does not get moved too rapidly and to make every shot overlap the last one, otherwise wastage may occur, as well as incomplete coverage. A greater forward speed is generally possible with hops and bush fruit than with trees, because of the smaller leaf surface area to be covered per foot of forward travel.

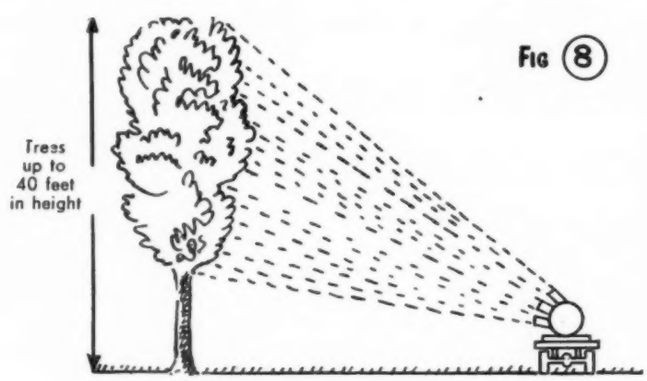


FIG (8)

Direct blast application by vertical swivelling action of mist blower. Each section of the foliage is penetrated and dealt with in turn

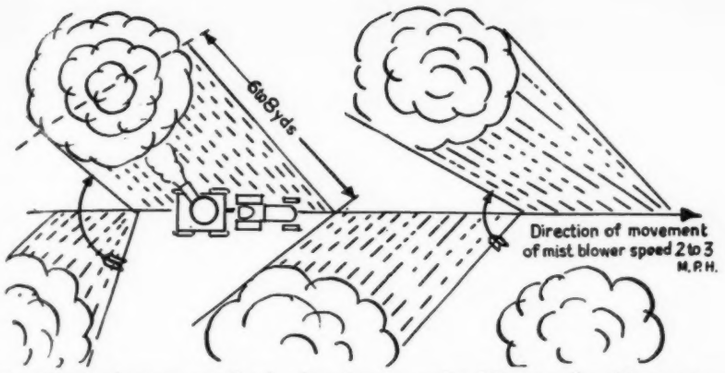


FIG (11)

The Wageningen method of using a mist blower for blast spraying of fruit trees. The nozzle is slowly oscillated from side to side and up and down

Plantation crops

Blast application by the Wageningen method is also recommended for spraying in cocoa and coffee plantations. Cocoa trees are comparable to medium-sized fruit trees and can be sprayed in the same manner. Coffee is something between a medium-sized tree and a bush, from the spraying point of view, the maximum height being about 10 ft. Orange trees are also dealt with in the same way.

Plantation crops which require drift application

Blast spraying cannot be employed for all types of plantation crops. For crops such as cotton and tea, and for locust destruction, the correct method of employing mist blowers is as drift sprayers. For insect destruction rather larger droplets are necessary than for fungus control. Droplets of 100 to 150 microns are recommended for insect destruction, and these are more satisfactorily placed by drift spraying than are smaller droplets. The latter, of 50 to 100 microns, tend to get blown about and dispersed when near ground level, due to eddy currents. Where it is necessary to utilise droplets of this size, it is advisable to increase the amount of spray liquid discharged per minute and to employ a lighter concentration of pesticide.

Tea plantations

In tea plantations of India and Ceylon the main enemy to be overcome is the fungus, blister blight, *Exobasidium vexans*. Blister blight tends to develop only on the top two leaves and the bud; the other leaves are thicker and more resistant. New shoots develop at the top level of the tea plant and grow towards the light. It is therefore satisfactory to spray tea plantations from overhead, and the drift spraying method can be employed. The main difficulties of uniformity of application and good coverage can be overcome by means of mobile mist blowers. In northern India the tea plantations are generally on plateaux and drift spraying is easily carried out. But in southern India and Ceylon tea gardens are on hillsides, and the problem is more difficult. It is usually necessary to adapt the spraying technique to suit the topography of the countryside; the wind must be studied and work must be done section by section. Special mist blowers for hillside tea plantations have been developed, and a modified method of drift spraying may be necessary.

Locust destruction

For locust destruction a lorry-mounted mist blower is employed and the pest is attacked, if possible in the desert, while still in the hopper stage. Heavy droplets are made use of and very effective results can be obtained.

Comparisons between various types of mist blowers

Enough has been said to enable the reader to have a fair idea of what can be expected from a satisfactory mist blower. It can be taken for granted that if a mist blower does not satisfactorily lend itself to utilisation in the ways suggested and does not give good coverage its merits are in general open to doubt. The types of mist blowers upon which this article is based are exclusively hand-guided low-volume machines, although for special purposes it might be possible and economic to develop and produce fully automatic mist blowers.

Spraying Residues on Tea in Ceylon

In the Annual Report of the Ceylon Tea Research Institute for 1950 recently published, it is pointed out that in protecting tea against blister blight disease by the use of copper fungicides two main questions arise from the chemical point of view, viz.:

(*a*) Is the fungicide being distributed uniformly over the whole area?

(*b*) What residues from the fungicide employed persist in the final manufactured tea?

In experimental work carried out in Ceylon under the charge of Dr. Dike of Universal Crop Protection Ltd., two methods of applying the fungicide were used, namely, wet spraying and drift dusting. In wet spraying the equipment used was a knapsack sprayer with a single lance, each bush being treated separately. Under these conditions uniformity of distribution was reasonably assured. In regard to drift dusting on the other hand, the applications were made by means of a large machine which could only operate from roads and paths. The question of distribution is being followed up in work at present in progress.

Of particular importance, however, was the problem of the effect of copper residues from the spraying on the made tea and on this exhaustive investigations have been made.

The main conclusions were as follows:—

(1) If tea in plucking is sprayed or dusted immediately after plucking and then subjected to the normal weather conditions which occur during the south-west monsoon during the next five to seven days, the made tea may be expected to have a copper content of the order of 70 parts per million.

(2) Under dry conditions tea sprayed at the rate recommended, *i.e.* 6 oz. of fungicide containing 50% copper per acre every ten days, the made tea may be expected to have a copper content of up to 100 parts per million. No comparable figures are as yet available for dusted teas.

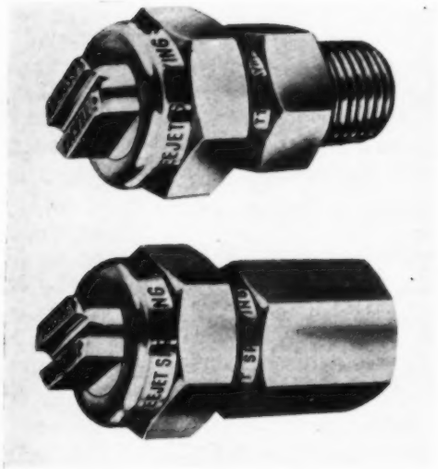
With the range of residues that can be expected to occur in the made teas thus ascertained, the question then remains how much copper passes into the liquor when making tea infusions.

Normal tea which has not been sprayed or treated, in any event contains about 25 parts per million of copper, and of this some 20% passes into the liquor.

Actually, out of 600 sprayed samples examined it was found that the copper contents ranged from 34.0 to 250 parts per million, with a solubility percentage ranging from 14 to 21%. It may be mentioned that the copper content of other beverages and food currently consumed often range much higher than this.

On the basis of these results the authorities in the United Kingdom granted a temporary tolerance of 150 parts per million of copper in made tea and this makes spraying of tea in plucking a possibility.

The Design of Nozzles for Spraying Equipment



TeeJet spray nozzles with (*top*) male and (*bottom*) female pipe connections

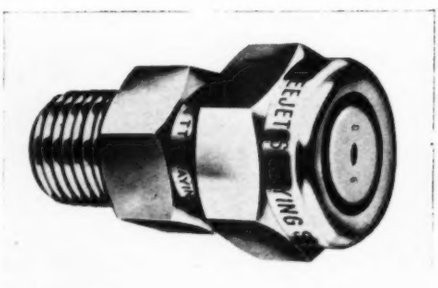
THE design of nozzles for the increasing number of different types of spraying machines is now a specialised branch of light engineering and not the least important application is in the field of agriculture and crop pest and disease control. Nozzles have had to be designed for spraying insecticides, fungicides, weed-killing chemicals, disinfectants, etc., and the machines themselves range from the specialised type of equipment for, as an example, aeroplanes, to the familiar, simply constructed plunger ' gun ' type of sprayer.

Basically the nozzle consists of a body, cap, strainer and interchangeable orifice tip, the body being designed for either male or female pipe connections. Selection of the orifice tip controls the type and capacity of the nozzle; for instance, the TeeJet flat spray nozzle gives a flat spray suitable for applying herbicides and insecticides, the flat spray effect being formed by the particular orifice tip used. This particular nozzle—the TeeJet—designed by the manufacturers, Spraying Systems Co., is made in three basic spray angle series, 65°, 73° and 80°, so designed that the spraying height (*i.e.* height of nozzle above crop) can range from 21-23 in. to 20-22 in. to 17-19 in. respectively. The nozzles are also designed to be spaced 20 in. apart and give a lap-edge pattern so that where the patterns overlap coverage is the same as in the pattern centre.

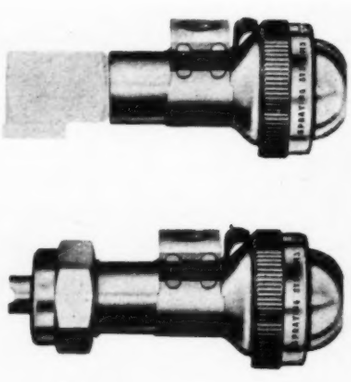
Disc-type nozzle

The cone-spray disc-type nozzle has been found specially suitable for spraying insecticides where larger capacities are required or where wettable powders are being used and sprayed at higher pressures than normal. This type has a stainless-steel orifice disc and a slotted strainer, the latter providing the approximate equivalent of a 25-mesh screen. The advantage of this type of nozzle is that suspended solids will not build up in the slots as they might do in the meshes of a screen.

Single swivel spray nozzle



Disc type nozzle giving a cone pattern spray



Airplane diaphragm nozzles with (*top*) whirljet, giving a cone spray pattern, and (*bottom*) with disc type orifice and cone

MulTeeJet tip assembly with four separate orifices in one nozzle; selection is made by rotating the turret head tip

Off-centre nozzles

For boom extensions and spot spraying the off-centre type of nozzle has been designed and is useful for covering areas inaccessible to booms equipped with standard nozzles, or for expanding the overall coverage width of a standard boom. There are several variations of this type of nozzle, principally depending on the extended body length and its angle of bend. The bodies are swivel-mounted and can therefore be adjusted for angle.

Large-capacity off-centre nozzles are used for spraying roadsides, ditch banks and similar places which are inaccessible to the tractor-mounted boom.

Aerial spraying

A diaphragm TeeJet nozzle has been designed for large field spraying contractors and aeroplane spray rig manufacturers. A diaphragm, which is made of a relatively resistant synthetic rubber compound, will make a perfect seal and give complete drip control. By using this method the nozzle is not affected by banking of the aircraft. A slotted strainer is used and the orifice is of the disc type.

Apart from the orifice disc, which is made of specially hardened stainless steel to resist corrosion and abrasion, nozzles are generally made of brass.

Wet Spraying Compared with Dusting for the Control of Blister Blight on Ceylon Tea

J. LAMB

Director, Tea Research Institute, Ceylon

The following paper, taken from the Ceylon Tea Quarterly, compares the effects of dusting and spraying for the control of blister blight disease of Ceylon tea during 1951. The paper brings out the limitations which apply to both methods under Ceylonese conditions.

THE year 1951 was undoubtedly a year of good growth conditions. Although it was certainly favourable to the growth of the tea bush, it was not wholly favourable to the growth of the organism causing blister blight disease. These observations apply particularly to the south-west monsoon zone but are equally applicable to the greater part of the tea-growing areas of Ceylon.

Blister blight attack

Even if spray protection had not been given, blister blight attack would most probably not have been so severe as it has been in previous years. However, spray protection was given over a very large area. At a rough estimate, based on the imports of fungicide and equipment, as well as on more direct information and observations, something approaching 200,000 acres received some degree of protection.

Conditions for spraying and dusting were good, and where crop protection methods were applied, success was easily achieved. Since the suppression of each blister prevents the production of several million spores, effective prophylactic treatment may be expected to have a very marked effect on an epidemic. Just as an epidemic attack builds up in geometric progression so the effect of control measures may be expected to have a very rapid effect on the general incidence of the disease. Large-scale spraying and dusting may well, therefore, have had a profound effect on the general incidence of the disease in 1951, and since conditions were on the whole favourable for the retention of fungicides on sprayed or dusted leaf, it is uncertain just how severe attacks might have been if there had been no attempt at protection. When protective measures are employed over large areas, control (unprotected) plots are to some degree less liable to infection and thus less reliable as indications of the success of prophylactic treatment.

Assessment of the success of attempts at large-scale crop protection during 1951 is, therefore, difficult. We must await a south-west monsoon bringing with it a long period of damp dull weather before anything approaching a final verdict is possible.

Wet spraying

The recommendations already published by the Tea Research Institute have proved to be adaptable to normal estate routine. We still recommend the use of 4 oz. of 50% copper fungicides dispersed in 10 gal. of water to be applied with pressure retaining knapsack-type equipment. The rate of application is variable but should average 12 to 15 gal. per acre. Spraying rounds should not be longer than ten days and in difficult circumstances may be reduced, with advantage, provided the plucking rounds can be adapted to allow spraying immediately after plucking. Under these circumstances the concentration of copper fungicide should be reduced in proportion.

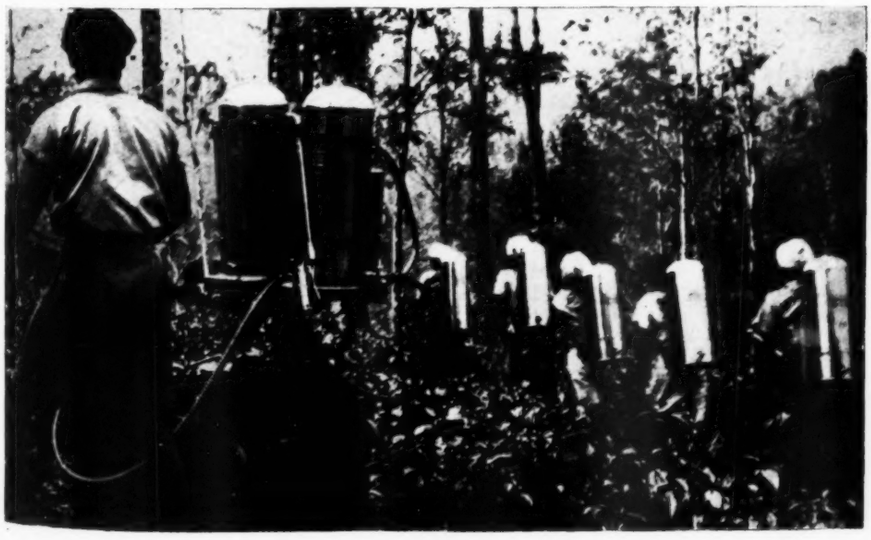
It is most essential that fungicides should be weighed and not measured by volume. A simple postal type of spring balance enables quick weighing into convenient tins (cigarette tins) which can then be packed into rainproof boxes in numbers sufficient for a day's supply for a spraying gang. Large containers of fungicide should not be taken out into the field and exposed to rain, with the additional danger of being left with the lid off. Stocks of fungicide must be stored in dry sheds and containers should be examined for damage on arrival. A damp fungicide may not disperse properly if stored for several months before use.

I have remarked previously that success with control measures was easily attained during 1951. The standard of work in some cases would not have met with equal success in a more difficult year, and although confidence gained at the start of an operation is a valuable asset, over-confidence or under-estimation of difficulties is highly dangerous.

Wet spraying is completely dependent for its success on the use of the correct jets operated over the range of pressures for which they are designed, on proper maintenance of equipment and above all on *organisation and supervision*.

We strongly recommend that superintendents should commence the next spraying season with a revision of our published recommendations, and a 'refresher course' of training for the labourers to be employed on spraying. Organisation must be reviewed and, if possible, improved. When results are not satisfactory blame the supervisor, the organisation and the labour before laying blame on the equipment or fungicide.

If we have a difficult south-west monsoon in 1952 there will be many cases of disappointing results as a consequence of



A party of workers in a Ceylon tea garden sets off armed with knapsack sprayers. Two machines in the foreground are being filled with fungicide from a tank

under-estimation of difficulties in 1951. The remedy to be applied has been clearly indicated. I wish I could recommend a method of 'spraying without tears' but for some time to come spraying must remain an exacting operation.

Dusting

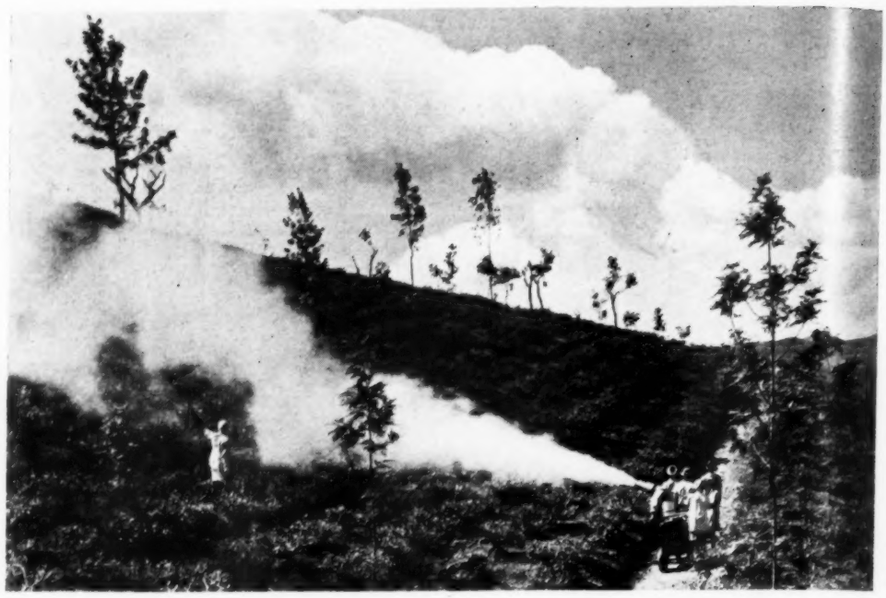
Having offered nothing but cold comfort in my remarks on wet spraying, I wish I could offer an easy solution to the difficulties of crop protection methods for tea under this heading. There is, however, no easy method of crop protection against blister blight and dusting must not be regarded as even a possible easy solution. The application of dust reduces labour requirements but the dust itself is expensive. Results with dusting in 1951 have been quite encouraging but experiments have indicated the limitation of the method[3] Recent articles by Loos[2] and Haworth should be studied in connection with this article. The important fact to realise is that hopes of being able to cover large areas from roads with an extensive blanket of dust is a mere pipe dream. Spectacular clouds of dust are not necessarily followed by spectacular results with protection.

Even with the best formulations of copper dust the vehicle or carrier (usually kaolin) has very definite limitations in the power to carry the active principle (*i.e.* copper), and it is unsound to attempt to dust bands of tea much more than 75 ft. in depth. This places very definite limitations on the scope for heavy power dusting machines and points to the need for light and efficient portable machines. During 1951 hand-operated dusters have proved to be extremely useful and will certainly have a very strong claim to extensive use so long as dusts are employed as vehicles for fungicides employed in Ceylon tea.

Most of the dusts tested in 1951 were totally unsuited for drift dusting over even short ranges, but those which 'carried' reasonably well proved capable of giving good control of blister blight so long as they contained 4 to 6% of copper.

On tea in plucking, 5 lb. of 4% dust applied every five days gave satisfactory control. On tea recovering from pruning we are at present inclined to favour 6% dust applied at five-day intervals at the same rate (5 lb. per acre). We still consider it unwise, however, to venture too far with attempts to control blister blight attacks on tea recovering from pruning. Trials should be limited to small areas until the reliability of dust is well established.

To sum up, therefore, we have obtained further satisfactory results with dusting in 1951, but cannot commit ourselves to unqualified commendation of copper dust for blister blight control purposes until further detailed trials have been carried out under the more severe weather conditions conducive to high levels of infection.



'Whirlwind' duster at work on a Ceylon tea plantation

Limitations of crop protection methods

Although tea leaf retains copper deposited by either wet spraying or dusting quite well under conditions of light rainfall, which are fortunately the conditions most favourable to the development of the blister blight disease, it is doubtful whether really heavy downpours of rain will allow leaves to retain sufficient copper to give protection for the required period of time. When wet sprays have dried on the leaf they will stand up to heavy rain and it is probable that dust applied to wet leaves is retained better when the leaves have dried with the copper on them. Fine spray deposits will dry rapidly even on very dull humid days.

Areas dusted or sprayed during heavy rain may, therefore, give disappointing results unless they are given further protection. North-east monsoon mornings with bright sunshine are ideal for spraying but work done during an afternoon downpour of the north-east monsoon type is probably almost useless.

On the other hand, dust applied in sunny periods rises in convection currents and will also adhere very loosely to dry foliage. The ideal time for dusting is before 8 a.m. on sunny days when cold air lies close to the ground and leaves are covered with dew or are wet from a previous day's rain. Dull overcast days and similar days with light rain are also favourable to the retention of copper applied in dust form.

When the relative merits of dusting and spraying are being considered, it is most essential that these limitations be borne in mind.

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2. Loos, C. A.: 'Studies on Blister Blight Control': (viii) 'Power Dusting with Cuprosana Dusts containing 2, 4 and 6% of copper,' *Tea Quarterly*, Vol. XXII, Part IV, p. 126; (x) 'Evaluation of Some Copper Containing Fungicidal Dusts in the Control of Blister Blight Disease of Tea,' *Tea Quarterly*, Vol. XXIII, Part I.
3. Haworth, F.: 'Distribution of Copper Containing Dusts,' *Tea Quarterly*, Vol. XXII, Part III, p. 118, 1951.

Photos: P. 345, The Tea Bureau; P. 346, Universal Crop Protection, Ltd.

Technical News

'Soya—Staple or Substitute' is the title of an article by E. N. Learmonth in the current issue of *Food Manufacture*. Dr. J. L. Boyle writes on the manufacture of Lanolin in the *Manufacturing Chemist;* also in this journal are 'Progress Reports on Fertilisers'—a regular feature. In the October issue of *Muck Shifter*, R. J. Salter has contributed an article entitled 'Recent Developments in Concrete Road Construction.'

Other technical articles this month include: 'The Raising of Wool Fabrics' by R. S. Audley in *Textile Industries and Fibres;* the 'Molecular Model Theory' in *Paint Manufacture* and a review of the French refineries in *Petroleum*.

Building Digest features an article on concrete road construction.

Aerosol Dispersal of Insecticides

THE method of dispersing liquids and emulsions into so-called 'aerosol' form has aroused considerable attention of recent years, particularly in the United States. Now, in the U.K. a new company, Microsol Industries Ltd., is manufacturing four models of aerosol generating machines under licence from the Silver Creek Precision Corporation of America. In the United States the use of these 'Microsol' units is reported to be spreading rapidly, particularly in warehouses and similar places where food in bulk is stored. A considerable amount of experimental work is being done in Great Britain and interest has been shown in Microsol by the Government Insecticide and Fungicide Research Council, East Malling Research Station, the National Institute of Agricultural Engineering and the Ministry of Agriculture (Infestation Control Division).

Operating principle

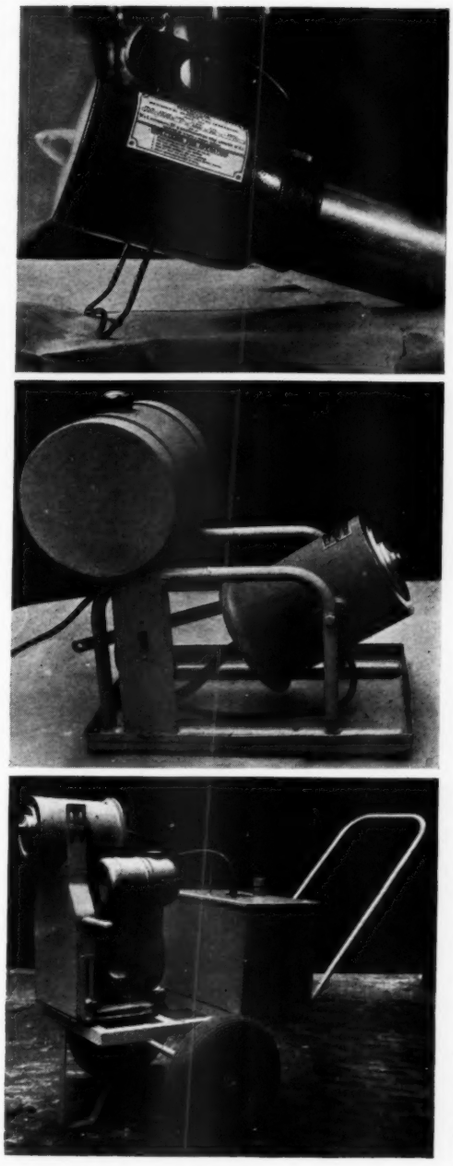
In all four models the operating principle is the same. The liquid is sucked from a container, through a valve and into a hollow shaft, at the end of which there is a transverse hole. On either side of this hole and transverse to the shaft are set two or more aluminium discs, spinning at 15,000 r.p.m. Between these discs and round the shaft hole is another plate with a slotted flanged rim, known as the distributor, and through which the liquid passes before being flung round by the spinning discs and emerging between them in a fine mist of particle size ranging from 5 to 125 microns (1 micron equals 1/25,000th of an inch). A fan, producing a powerful air blast, works in conjunction with the spinning discs to give the fine aerosol effect, the size range of which is valve controlled, and directional stability and turbulence to the fog.

Thus it will be seen that this machine has neither pump, air pressure nor agitator. Large holes reduce clogging to the minimum and the servicing of the machine is an easy matter.

Use of the Microsol

The control over particle sizes is of great importance, having regard to the use to which the machine is to be put, *e.g.* small particles for insecticide use against flying insects and larger particles for, say, formaldehyde solution as a terminal disinfectant, or for residual work with heavy formulations.

Complementary to the production of an aerosol is its circulation in the premises in which it is being used. The turbulence given to the aerosol and the air by the air blast from the machine ensures that all parts of the warehouse, for example, are penetrated by the chemical.



From Top to Bottom: Microsol models 202, 303 and 304. Model 303 shown here is a special prototype developed for the Ministry of Agriculture in the U.K.

Certain insecticide concentrates may be put through the Microsol without any fillers or carrier materials, or at any rate with only the barest minimum. In such circumstances accurate doses would have to be determined. Using the model 202, 25,000 cu. ft. of space can be filled with a thick aerosol mist in four to six minutes, from one position. The 303 and 304 will spray 350,000 cu. ft. in the same time and also from one position.

Models in production

Of the four available models, two are powered by electricity and two petrol-driven; the latter are the larger machines and more likely to be used out of doors on farms and plantations where electric power is not available.

The smallest model, the '202,' is an indoor machine having a container of ½-gal. capacity and valve control to regulate output. Next in size is the '303,' of which there are two models—the standard American model and a prototype developed by Microsol Industries Ltd. for the Ministry of Agriculture (Infestation Control Division). This has a capacity of 2 gal. and will space spray 350,000 cu. ft. *from one position.* Its output is 33 gal. per hour with a range of particle size of 5 to 125 microns. Model '304' is the same machine as the '303,' only petrol driven and with a 5-gal. container. It is mounted on pneumatic wheels and is popular with market gardeners in America. Finally there is the '403,' the largest machine of all. It has an output capacity of 165 gal. per hour and sucks up liquid from any container, having no tank of its own. This machine has been used for mosquito control, locust control, on tea, coffee and rubber plantations and on cocoa farms.

Examples of use

Experiments on the use of the Microsol were recently carried out by the Horticultural Department of Ontario Agricultural College with the object of using this type of equipment in the small greenhouse. For houses up to 14,000 cu. ft. capacity, distribution was found to be satisfactory by placing the machine at one end of the greenhouse. For houses up to 25,000 cu. ft. capacity it was found necessary to move the machine down the length of the house, which became cumbersome in houses over 100 ft. in length because of the necessity for using long extension flex. Satisfactory results in larger houses (50,000 cu. ft.) were, however, obtained by suspending the Microsol above the plants in the centre of the greenhouses. Allowing the machine to run for at least 15 minutes after all the material had been dispensed was found to give better distribution. The formulations used in these experiments included 7% parathion in hexanol at the rate of 1 gm. parathion per 1,000 cu. ft.; also HETP, TEPP and Dithio.

The Microsol was found to be well suited for mosquito control in Florida, giving good results on open marsh and also in the dense grove of mangroves and palm trees surrounding the water, an area where spraying aircraft could not obtain control. A fog produced by the Microsol is stated as having given good control for a quarter of a mile through jungle growth.

A flour and cereal packing factory in Newcastle was treated against adult mill moth (*Ephestia Kuhniella*) by the model ' 202,' the insecticide used being a mixture of pyrethrum, piperonyl butoxide and white spirit. Each floor was first treated and afterwards the machinery installations were treated while they were running empty. Dosage was equivalent to 0.1 gm. pyrethrum per 1,000 cu. ft. Actual working time for the machine throughout the premises was 25 minutes. Knockdown was not complete for eight to eleven minutes and death in some cases did not take place for 40 minutes. No live or moribund adult moths were recovered.

The future

At present in England a considerable amount of research is being carried out with this type of machine and it is beginning to be used overseas on plantations of tea and coffee in particular. Its uses in the agricultural field are extensive and the aerosol may be an important factor in crop pest and disease prevention in the years to come.

WORLD CROPS

OUR NEXT ISSUE will include a review of some varying systems of **tea cultivation,** written by Dr. T. Eden, Director of the Tea Research Institute of East Africa.

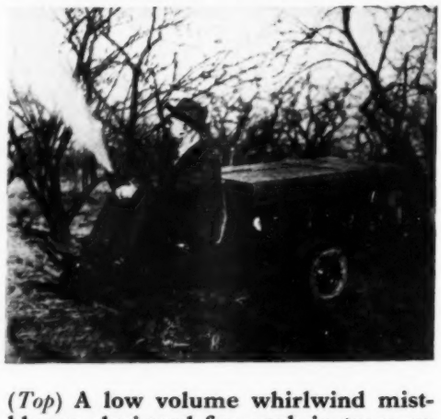
John Grindrod writes on the **Columbia Basin Irrigation Project,** a vast system of irrigation work now in progress in the north-west U.S.A.

A further article on agriculture behind the Iron Curtain is contributed by John Cardew, who wrote about China's crops in our August issue this year; next month his subject will be **Rumania.**

Industry's Contribution to Agricultural Research, No. 11, will be **The Toxaphene Story,** describing the development of toxaphene insecticides by the Hercules Powder Company Inc.

Other articles and regular features will also be included in the November issue.

SPRAYING AND DUSTING EQUIPMENT



(*Top*) **A low volume whirlwind mistblower designed for work in trees up to 40 ft. high.** (*Bottom*) **A whirlwind master with variable rates of application for work in trees up to 30 ft. high**

Orchard Low-Volume Sprayers

Two new low-volume spraying machines, primarily designed for orchard work, have recently been introduced by Messrs. Universal Crop Protection. Similar to the original ' Whirlwind ' spraying and dusting machines, the new ' Mistblower ' and ' Junior Whirlwind Proff,' use the principle of atomisation by air blast and are claimed to be the first low-volume sprayers suitable for top fruit work.

The ' Mistblower,' which is the larger machine of the two, sprays up to 50-ft. high a spray composed of droplets ranging from 80 to 100 microns. An 8-h.p. petrol engine drives the pump and large fan, giving an output of 1½ gal./min.; the pump actually works at the rate of 14 gal./min., the remaining 12½ gal. being recirculated through the tank which holds 90 gal. An ingenious method of agitation is effected by driving the agitator paddles from the land wheels of the machine.

For orchard work the normal rate of spraying is 25 to 50 gal. per acre. The machine is also being tried out on coffee in East Africa. The weight is 11 cwt. and the machine, which has been designed in Holland, is expected to sell at about £690.

The ' Junior Whirlwind Proff ' is for smaller trees of up to 30 ft. in height. A 4½-h.p. engine drives the pump and also a rotary air compressor which provides air at a pressure of 240 lb./sq. in. The variable double piston pump can provide up to 1¾ gal./min. of liquid from the 45-gal. tank. A swirl-type nozzle is used in conjunction with an air blast swirling in the opposite direction, so that when the liquid comes into contact with the air it is broken up into a fine spray of droplet size ranging from 40 to 80 microns. On/off control is effected by foot control. Agitation of the liquid in the tank is done by paddles driven from the engine.

Power Dusters

A principle which does away with all moving parts, with the exception of the fan, has been used in the design of Tornado Jet Dusters made by **W. J. Craven and Co.** of Evesham. A new principle of agitation by means of a venturi tube and an air jet is employed, the quantity of powder to be applied being regulated by a handle on the side of the hopper which controls the flow of air to this jet. The engine specification is a Villiers Mark 20, two h.p. four-stroke air cooled, with special carburettor and governor. The fan runs at 5,000 r.p.m., giving an air speed at the fan outlet of 116 m.p.h. Hopper capacity is 2 cwt. of normal dust, and the dusting rate ranges from ¼ lb. to 12 lb. per minute according to the type of powder. This machine is claimed to give a horizontal dusting swathe of 500 to 800 ft., according to wind velocity, and a 60 to 80 ft. vertical swathe in still air. It has been designed in two sizes, the Tornado Jet Senior, which is a tractor- or horse-drawn machine especially suited for drift dusting through a direct outlet or through a 28 ft. boom for the application of dusts to ground crops or turf. A smaller machine, the Tornado Jet Junior, has a smaller capacity and is suited for hand operation.

A rotary fan dust gun for dusting ground crops, fruit trees, vines, cotton, etc., is the Rotver, manufactured by **Cooper, Pegler and Co.** of Burgess Hill. It is a hand-operated machine, carried on an adjustable belt round the waist and supported by a strap round the neck. On one side of the container is a fan running on ball bearings and completely encased, and on the other side is a crank case containing gearbox and crank handle. The crank handle has a

The Micron sprayer in operation in Ceylon against the vector of the filariasis germ, a 'bush-resting' mosquito

speed of 35 to 40 r.p.m., geared to give 2,500 to 3,000 r.p.m. of the fan. A lance rotates on its axis through 180° enabling dusting at any angle, either upwards or downwards. The container has a capacity of 15 lb. and weighs 10 lb. Two models are available; single outlet, 16 in. lance, angle bend and spreader, and the double outlet, 16 in. lance, one 'Y' piece with flexible metal tubes and two spreaders.

Made by the same firm is a high-powdered duster for rubber, citrus, cotton, etc., named the 'Pulvover' and consisting of a five h.p. petrol engine, high-speed fan driven by three 'V' belts, a container holding 150 lb. of powder, a distributor controlling output from 35 lb. to 630 lb. per hour and an automatic agitator. This machine can be mounted on a two-wheel chassis with either a flexible metallic hose lance, ten-row adjustable lance for ground crops or a four-row adjustable lance for treatment of bushes, vines, etc.

Low-Volume Spraying in Ceylon

An interesting development in low-volume spraying took place during July in Ceylon, where the Dominion's rubber planters are always on the lookout for new weapons in their unending battle against *Oidium* leaf disease. The Rubber Research Institute of Ceylon, in view of the difficulties attendant on sulphur-dusting mature rubber trees, began extensive test of spraying lime-sulphur wash with the Micron Sprayer manufactured by Messrs. Clean Crops Ltd. The preliminary results were highly encouraging, for not only did the beam of finely atomised spray easily top the 80-ft. mark, but the very fine particles (100 micron), unlike dust particles, firmly adhered to the leaf surface and were no longer at the mercy of the first shower.

While these tests were in progress, the help of the Micron sprayer was also enlisted by the Ceylonese Health Department for their anti-elephantiasis campaign in spraying the breeding grounds of the mosquito vector of filariasis. The method involves spraying the affected areas with oil-based DDT in the shortest possible time. Experience has shown that the Micron sprayer can lay down a dense screen of insecticide over an area of swampy ground two acres in extent in one minute. The accompanying picture shows the machine in action.

New Chemical Kills Locusts Faster

Plant Protection Ltd. announce that a new BHC insecticide, 'Acrodel,' which destroys locusts more rapidly than any other substance so far used, has been the subject of trials carried out in Iraq and Jordan by Mr. J. H. Stapley, senior entomologist at the Fernhurst Research Station of Plant Protection Ltd. 'Acrodel' is not poisonous to human beings or animals, and its use should greatly facilitate the anti-locust campaign.

The trials, which were undertaken for the Governments of the two States, were an extension of work done in previous years. The work is also being followed up in East Africa. 'Acrodel' is a liquid BHC formulation which is applied by low-volume sprayer at the rate of 2 pints in 2 gal. of kerosene per acre against locusts in the hopper stage.

Concerted Effort Against Greenfly Plague in Kenya

THIS growing season in Kenya has been extraordinarily dry. About August 5 some farmers in the great Rift valley north of Nakuru noticed a greenfly in considerable numbers upon their cereal crops—notably wheat.

Identification

The Agricultural Department and the Government entomologist were notified and after inspection they suspected the insect to be either *Toxoptera graminis* (the 'green bug' of America) or *Aphis maidis* (the corn aphis). Samples of the insect were sent to the British Museum for identification and the Government requested farmers to inspect their crops and notify the authorities if they found the insect in large numbers.

After the warning, inspection by individual farmers revealed that the insect had become a plague almost unnoticed and that enormous areas were affected. Crops that, upon the daily casual inspection, had looked healthy, proved to be infected and the damage had already been done. With the passage of the days these crops began to dry up and fade away.

By August 13 the Government had been trying out various chemical formulations to see if they could combat the insect. They had obtained a grant from the Colonial Office in London to spend in the attempt to control the insect and had also asked the Colony's two contract spraying organisations (Messrs. Bates & Hunt and Pest Control Ltd.) for their support in the campaign. Other insecticide concerns offered their support as far as supplies of materials were concerned.

On August 13 trials were inspected and the most effective materials appeared to be Agrocide 7 at a rate of 5 lb. per acre sprayed at high pressures, and Parathion.

Combined operation

It was decided that Pest Control Ltd. should go ahead with the Parathion spraying and the other contractors were to spray the Agrocide 7, the plan being to try to encircle the infected area as soon as possible to prevent the spread of the insect to new areas. Meanwhile, further machinery that was just arriving at Mombasa was cleared under special order and rushed to Nakuru.

Later the same day reports received showed that at least 10,000 acres of wheat had been seriously affected and that a further 50,000 acres were threatened. The task of 'boom' spraying the enormous areas involved seemed very difficult and

(*Concluded at the bottom of p. 350 overleaf.*)

RESEARCH DEVELOPMENTS

A New Systemic Insecticide

FOR better or for worse agricultural chemistry owes a great deal to Gerard Schrader, German World War II discoverer of the phosphorous insecticides. These dangerous but infinitely useful substances were first synthesised by Schrader as a group of possible alternatives for nicotine, and poisonous though they may be the phosphorous insecticides are being used on an increasing scale as plant protectants. This despite the physical hazards to spray-men and the crop consumer.

Systox

Among the relatives of Parathion and TEPP are the comparatively staple water soluble materials, the systemic insecticides, best known of which is Pestox III but also called Schradan. Britain took the lead in determining the agricultural possibilities of systemics and showed commendable foresight and courage in putting technicians to work in what was virtually an economic No Man's Land. With Britain's lead established, America now appears to be disputing the position and is forging ahead with the development of a new and promising systemic, Systox. Like Pestox III, Systox is another Schrader material.

Chemically it is 0.0 diethyl, 0.2 (ethyl mercapto) ethyl thiophosphate. It is readily soluble in the common organic solvents used in the formulation of insecticides and as currently distributed in the United States is available as an oil emulsion containing 31 to 32% of the active ingredient. Unlike Schradan, which is readily soluble in water, Systox is soluble to the extent of only about one part in 15,000, so that eventually formulation costs of the newer material may well be higher than those of the well-established Schradan[1].

Properties

Systox is rapidly absorbed by plant surfaces, both leaves and roots, and the material may be applied as a soil treatment by watering the poison around the plant's roots or as a spray directed on to the foliage. Tests also reveal that seeds, if moistened or soaked in Systox solutions take up the poison which, after the seeds have germinated, protect the young plants. One group of workers has also absorbed Systox on to activated charcoal and worked the systemic and its carrier into the soil either at the time of sowing or just before transplanting.

When applied in mixed washes containing fungicides or other insecticides, experience shows Systox to be compatible with all except alkaline materials. Thus the new systemic may be mixed with modern synthetic insecticides like DDT and Chlordane, with mineral oils as used in dormant washes and with vegetable insecticides such as Derris. With fungicides, Systox is compatible with copper, sulphur and quinone-type materials, but it is not recommended for use with lime sulphur or Bordeaux mixture. When mixed in the proportion of 0.15 lb. Systox with 2 lb. toxaphene, a synergistic effect has been reported.

On a range of 66 ornamental plants treated in greenhouses, Systox was safe for use at 3 lb./100 gal. of spray wash, but at this concentration the systemic damaged 12 other plant species. The affected plants grew away from the damage.

Examples

As an extension to these greenhouse studies it was found that Systox controlled citrus mealy bug, greenhouse white fly and the aphid *Myzus persicae*. Some of these kills were registered from old plants, an important observation since, in general, systemic insecticides are not as effective on old as upon young plants. The economically feasible rate of $\frac{1}{2}$ to $\frac{3}{4}$ lb. of Systox per acre killed half-grown and bigger larvae of the cotton leaf worm (of America), but experiments with the American bollworm showed Systox to be ineffective in controlling its caterpillars. Thus Systox may not be in much better case than Schradan when it comes to controlling caterpillars.

As a soil treatment on egg plant against the attacks of flea beetle, Systox was successful, while the protection afforded to the plants also checked damage from a plant bug. Yields from treated plants averaged two to four times more than those from control plants growing nearby. Systox also has proved its value in trials on field cabbage heavily infested with mealy cabbage aphis, *Brevicoryne brassicae*. In replicated row trials both Systox and Parathion gave 99 to 98% control, but in a second trial designed to test residual effectiveness, Systox gave a better, longer lasting control than did Schradan used at a slightly higher rate. Tests on peas, where the insecticide was applied to the soil, to the foliage or to the seed before germination, showed that Systox gave excellent control of the pea aphid *Macrosiphum pisi*. Throughout the 80 days of the trial the crop remained comparatively aphid-free, and towards the end of this period inspections showed the existence of healthy populations of predatory insects. Further data will be required before one can be certain that Systox is as 'kind' to predators as is Schradan.

Currently recommended by the National Cotton Council of America[2], Systox is approved for experimental use on American grown cotton during 1952. The recommendation calls for the use of $\frac{1}{2}$ to $\frac{1}{4}$ lb. Systox per acre, or $\frac{1}{4}$ to 1 lb. of Schradan per acre in trials against cotton aphis and cotton red spider. This dose is expected to be as effective as $\frac{1}{4}$ lb. of Parathion. The Council's recommendations were accompanied by the caution that Systox was very toxic to man and that the material should be handled with as much care as Parathion.

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1. *Agric. Chem.*, 1952, **7**, 53, 111.
2. *J. Econ. Ent.*, 1951, **44**, 747; 1952, **45**, 118, 302, 326.

ALAN GOODMAN

Kenya Greenfly Plague—*concluded from previous page.*

in order to try to protect vast areas quickly Universal Crop Protection Ltd. took one of their 'Whirlwind' power dusting machines to Nakuru for trials with a dust insecticide. Since BHC dust formulations had not proved very effective in the previous trials, they tried 'applying ground Pyrethrins. Unfortunately, this material did not prove to be very effective. Further trials were to be made with BHC formulations, since little faith was placed upon the results obtained in the previous trials, due to the fact that the application of the materials had not really been very good.

The insect is a difficult pest to reach because it spends most of its time feeding beneath the leaves or right down in the sheath of the wheat.

The pest itself is always present in Kenya and the weather conditions that have prevailed over the past two seasons seem to be responsible for its sudden increase this year. Last season was abnormally cool and damp, allowing the insect to multiply; this growing season has been slow and dry, so that when the insect attacked the crop it was not in a condition to overcome the attack.

One bright spark in an otherwise gloomy picture was the way in which the commercial firms and the Government so readily combined to fight the plague together.

Agricultural Development in Surinam

D. H. GRIST

Surinam or Dutch Guiana is one of the tropical parts of South America where for various reasons development has stagnated. Owing to changed conditions the Dutch have latterly decided to embark on plans for large-scale development. In the following pages Mr. Grist, who has recently visited this part of the world, outlines the projects envisaged.

DUTCH GUIANA, or more properly Surinam, is the only Netherlands colony on the American mainland. It is situated in north-eastern South America between latitude 2° and 6°N., and longitude 53° 50° W., with French Guiana on its eastern border, British Guiana on its west and Brazil to the south. On the north it has a coast of some 240 miles on the Atlantic Ocean.

Some 200 years ago it was a flourishing colony with 500 plantations producing sugar, coffee, cotton and cocoa and was ranked as the richest of the Dutch possessions; today there are but 30 plantations, many of which are not particularly prosperous. The decline in prosperity of Surinam was due to the abolition of slavery in 1863 and to the opening of the Suez Canal; the former deprived Surinam of cheap labour, the latter brought the products of the East, where labour was still cheap and plentiful, closer to the markets of the West. Furthermore, it directed Dutch capital and enterprise to the Dutch colonies in Asia and away from Dutch Guiana.

Once again the pendulum has swung. The granting of self-government to the Netherlands East Indies, political unrest in Asia and the larger consumption by Asiatics of locally produced staples has directed attention once more to Surinam, where conditions are more favourable than hitherto for agricultural development. The extensive area of fertile coastal land there only awaits adequate water control, while the undeveloped hinterland is accessible through the many small rivers which are navigable for small ships. With the use of modern labour-saving methods to overcome the shortage of labour, supported by scientific research, Surinam is considered ripe for development in several directions, particularly in agriculture.

To assist this the Government of the Netherlands has created a special fund of 40 million guilders which has enabled a five-year plan to be started. It is proposed to use this money for a survey and inventory of the possibilities for capital investment in agriculture, fishery, forestry and animal husbandry, mining and secondary manufactures and to create labour conditions which will lead to increased productivity.

In this projected economic development, agriculture is considered to be of paramount importance. In co-operation with the Surinam Government, the Eysvoogel and the Lelydorp Plans have been commenced to investigate by actual experiment what crops are suitable for development, and to reclaim land in the fertile western coastal area.

Map showing position of Surinam (or Dutch Guiana) in relation to neighbouring South American territories

The Lelydorp Plan

The Lelydorp Plan is considered as the first and experimental stage of the possible development of the Savannah belt of Surinam. This Savannah belt is situated immediately south of the low coastal lands and is of a light sandy nature. The rainfall in this area is adequate and drainage is stated to be comparatively simple.

The main objective of the Plan is to settle farmers, such as creoles, Netherlanders and Indo-Europeans, on farms of 40 acres each. During the initial stages the farmers will be employed on a wage basis and if they are found to be satisfactory they will then be allowed to acquire farms but will be required to follow directions as to cultivation, crops and general farm administration. These prospective farmers will make a deposit of F.5,000 as a security with the Peoples Credit Bank, returnable if the farmer is removed from his farm for unsatisfactory farming.

Preliminary work has already commenced to develop a tract of about 5,000 acres for large-scale experimental work and a number of crops are already established. Ultimately this unit of 5,000 acres will be divided into 125 farms. It is considered that a unit of 5,000 acres is the minimum area necessary to provide a workable project for the processing and marketing of the produce.

Other experimental work is in hand which should be of benefit to farmers. A cocoa plant selection station has been established; a citrus research institute is also working to improve what is already a Surinam industry, and credit has been provided to start a factory for preparing fruit juices.

A personal visit to the experimental area convinced the writer of the very thorough way in which the project is being worked out, backed as it is, by investigators with very considerable experience of similar work in the Netherlands East Indies.

The Eysvoogel Plan

The Eysvoogel Plan contemplates the ultimate reclamation by empoldering 150,000 to 500,000 acres of swampland in the coastal area. Rice will be the main crop cultivated, but pulses may be planted

in the second yearly rainy season. As a preliminary to discussion of the Eysvoogel Plan, a brief review of the present position regarding rice production in Surinam may be useful.

Rice production

There are some 40,000 to 50,000 acres under paddy, producing about 57,000 tons of rice, grown on smallholdings by hand labour. Of late, however, mechanical methods are becoming popular where the holdings are large enough for the purpose. Tractors are used for grading and levelling the fields; disc ploughing to a depth of about 4 in. is usual, and seed drills are also in use. The crop may be harvested by hand or, where circumstances permit, by combine. The yield is high, usually about 2,800 lb. per acre.

The crop of paddy is either sold privately or to the government if the quality of the crop is considered suitable for the export trade (with a tolerance of 7% red rice, 2% discoloured grains, 0.5% impurities and 15% moisture). The government owns two warehouses especially designed for the storage of paddy. The flooring in these is made of two layers of concrete; the lower layer is of ordinary concrete about 8 in. thick. Above this is laid 2 ft. of porous concrete, obtained by mixing cement with rice husk. Above this is placed tarred paper on the top of which are air ducts. Paddy is stored in bulk and hollow bamboo rods are placed in the paddy at intervals of 8 ft. with their ends projecting above the top of the paddy. Through these rods the temperature of the grain is tested periodically and cool air, supplied by a fan, is circulated through the ducts, thus regulating the temperature and ensuring that the paddy is maintained in a dry condition.

Under the Eysvoogel Plan the first stage of 12,500 acres will be empoldered and divided into 64 farms of about 200 acres each. Not only will a polder be constructed and drainage and irrigation canals supplied, but provision will be made for 64 farmhouses, a recreation hall, shops, schools, church, hospital, houses for personnel and stores, a central workshop, a central machine park, a central drying plant and silo and a power plant and pumping stations for the drainage, while measures will be taken to ensure economical transport. The execution of the work of which the preliminary measures have been enentrusted to a non-profit making institution called 'The Foundation for the Development of Mechanised Agriculture in Surinam,' was created by the Netherlands and Surinam Governments for this purpose.

Present-day Surinam. (*Top to Bottom*): **Construction of a drainage canal; the many small rivers are navigable for long distances; breaking new paddy land by tractor; drilling paddy seed**

Pattern for development

It is intended that in this first stage financially independent and experienced Dutch emigrants will occupy the farms; the people of Surinam do not possess either the capital or the expert knowledge needed for the development of an agricultural enterprise of this magnitude. The initiative to emigrate to Surinam originated with Dutch farmers themselves, who despatched a mission to investigate the possibilities of mechanised farming in Surinam and satisfied themselves on this point. Dutch farmers are familiar with polder farming and have the experience and skill required to ensure success.

Scarcity of labour in Surinam makes mechanised farming on a family basis essential. For this reason the size of the farms has been fixed at 200 acres. Many of the farm implements will be pooled and be available for hire with their operating crew, thus reducing the individual investment for machinery by 30%. A grazing meadow has been included in the rotation for each unit which will be broken up periodically and will carry about 24 head of cattle. The smallest economic co-operative unit is a polder of 12,500 acres.

Experience elsewhere has shown that mechanised rice cultivation is possible, and one successful project of this nature has been in operation in Surinam since 1928.

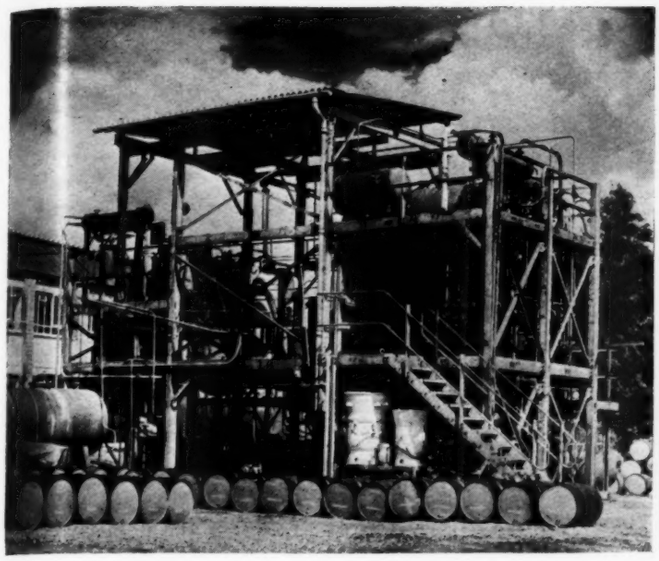
This Plan offers considerable advantages both for Surinam and the Netherlands. It should assist to a material degree in raising the level of agriculture in Surinam and should increase available food supplies both for the Netherlands and locally.

Moreover, land in the Netherlands is becoming increasingly scarce and every year the need arises for additional land to meet the needs of over 12,000 people. It is hoped and expected accordingly that this project for developing the resources of Surinam, combined with the concomitant possibilities of developing secondary manufacturing industries, may in due course help to relieve the growing pressure of population in Holland and at the same time ensure the profitable development of the unutilised resources of Surinam.

Gammalin Liquid Concentrate

Plant Protection Ltd. have recently drawn attention to a new insecticidal preparation which they have placed on the market under the name '"Gammalin" Liquid Concentrate.' It is a BHC preparation capable of being used for the purposes for which BHC is normally employed but which is considered to represent a considerable technical advance in that it is based on the technically pure gamma isomer of Benzene Hexachloride and not on crude BHC; the latter represents a mixture of several isomers and possesses the disadvantage that it is liable to taint crops treated with it or grown on land to which it has been applied.

Gammalin insecticides are stated to be comparatively free from these taint hazards and can be used for control of insect pests on susceptible crops with little risk of tainting them.



(*Left*) **Chemical plant for the manufacture of systemic insecticides.** (*Right*) **A corner of Place Farm, original home of the Company and now devoted exclusively to research laboratories**

INDUSTRY'S CONTRIBUTION TOWARDS AGRICULTURAL RESEARCH—X

The Murphy Chemical Company

G. A. EMERY, M.A.

This month's article in the current series concerns the work of the Murphy Chemical Co. and indicates the many directions in which the work of this organisation has assisted in the problem of controlling pests and diseases of crops in the field and in the glasshouse.

IN 1887, the late A. J. Murphy founded the firm of Murphy and Son Ltd. as technologists in the brewing and allied industries. It was originally situated in Leeds, with additional offices and laboratories in London. Later a factory was acquired in Nottingham, which is still the main manufacturing centre of Murphy and Son Ltd. The head office was moved to Wheathampstead House, Wheathampstead, in 1928. As the firm developed, the scope of its interests widened considerably to include research and development of chemicals for the horticultural and agricultural industries.

This department of the business, started immediately after the first world war, grew so rapidly that in 1931 a separate Company was formed—The Murphy Chemical Company Ltd., of Wheathampstead, St. Albans, Herts., specialising entirely in the development and manufacture of horticultural and agricultural insecticides, fungicides and crop protection products generally. The parent firm, Murphy and Son Ltd., continues its well-known work in the field of brewing technology.

Location of the Company

The Murphy Chemical Company's premises are situated in rural surroundings in the village of Wheathampstead, where they have gradually expanded from their original centre in Wheathampstead Place, a 16th century house now devoted exclusively to laboratories. The Company also occupies a number of other buildings in the vicinity as offices, laboratories and technical departments, while the factory and storage extend over the original farm land. The site includes a range of glasshouses for the breeding of plants for testing purposes, as well as further laboratory buildings; a large new biology block is projected in the near future. There are also orchards and market garden plots for screening test work on new materials.

Scope of the work:

Winter washes

The Murphy Chemical Company has been foremost in the development and manufacture of fruit tree winter washes. It was the first firm in the United Kingdom to make tar oil winter washes; 'Mortegg,' for instance, has been a household name in fruit-growing circles for 30 years. The Ministry of Agriculture stated, in 1941, that the introduction of tar oil washes in this country about 1921 resulted in the greatest advance in the control of fruit tree pests that had been made in the present century up to that time. The part played by industry in the development of these washes and winter washes generally is sometimes inadequately recognised. 'Mortegg' was soon followed by 'Mortoyle' petroleum, 'Capsomort' tar-petroleum and 'Thiol' thiocyanate winter washes. The Company was also among the first to develop the use of dinitro-ortho-cresol petroleum oil winter washes; its 'Ovamort' is known in many countries of the world. Most recent winter wash developments have been in high concentration DNC products whereby both cost of material and transport charges are greatly reduced.

DDT formulations

During the war the potentialities of DDT were investigated, with the result that on cessation of hostilities the firm was the first in the United Kingdom to offer this new insecticide for horticultural uses and to supply formulations of very high standard. Since then it has maintained its position as a supplier of DDT products, contributing at least one new method of formulation of particular merit in DeDe-Tane Paste. This product, which has been described in a previous issue of WORLD CROPS, is an aqueous suspension of micro-

A part of the insect breeding rooms

crystalline DDT, prepared by the emulsification of molten technical DDT and subsequent crystallisation under strictly controlled conditions. Major advantages of this formulation lie in the exceptionally fine particle size and excellent suspension qualities. These properties render the material very suitable for use in sprayers which do not incorporate agitators, and in low volume sprayers. Recently this material has proved extremely valuable in the control of the new Apple Tortrix, *Adoxophyes orana.*

Industrial problems

Up to the beginning of the war, the Company specialised to a very great extent in the requirements of the fruit grower, and set out to fulfil his needs as far as insecticides and fungicides were concerned. The advent of DDT gave impetus to a further widening of its interests, to include the problems of pest control in domestic and industrial premises and in stored products. An industrial department was therefore formed which now operates largely as an independent unit known as the Murphex Division. This unit has recently included rodenticides within its scope. It maintains a research team of rodent operators to further the knowledge of rodent and insect control in the industrial field, and to test new formulations, methods and materials. Recently the Company has acquired an organisation providing a cleaning, painting and disinfestation service for flour mills and buildings of similar nature, particularly in connection with the control of rodents and other pests.

Staff

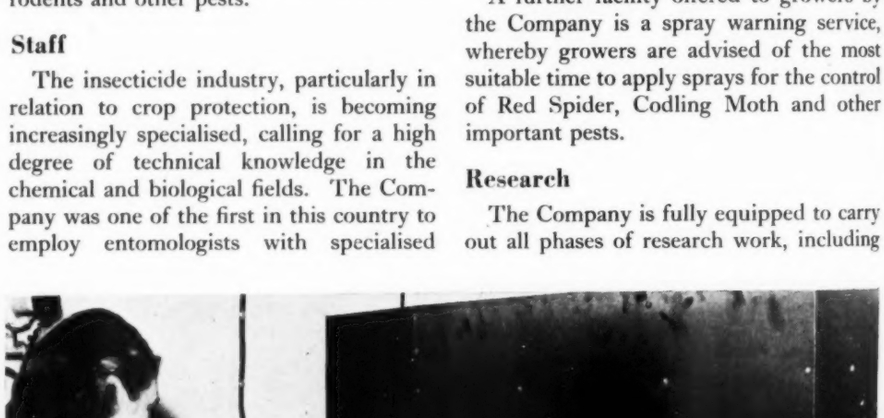
The insecticide industry, particularly in relation to crop protection, is becoming increasingly specialised, calling for a high degree of technical knowledge in the chemical and biological fields. The Company was one of the first in this country to employ entomologists with specialised training, and there has been a steady increase in technical staff, which includes fully-qualified chemists, entomologists, mycologists and plant physiologists, who are specialists in the horticultural or agricultural aspects of their science. The policy of providing the best technical knowledge and experience for the benefit of growers has been developed in the appointment of the Company's sales representatives. All such staff appointed in recent years in the agricultural and horticultural fields have been university or agricultural college graduates, with a sound practical knowledge of crop production as well as crop protection.

The Company operates a free advisory service, which is always ready to supply growers with answers to their many queries, particularly those of an unusual nature beyond the scope of the outside representatives; where necessary, visits are paid by members of the firm's advisory staff. Each year, several thousand advisory letters are sent out, both at home and abroad, dealing with every aspect of crop protection; in addition, occasional lectures are given to horticultural associations and similar bodies.

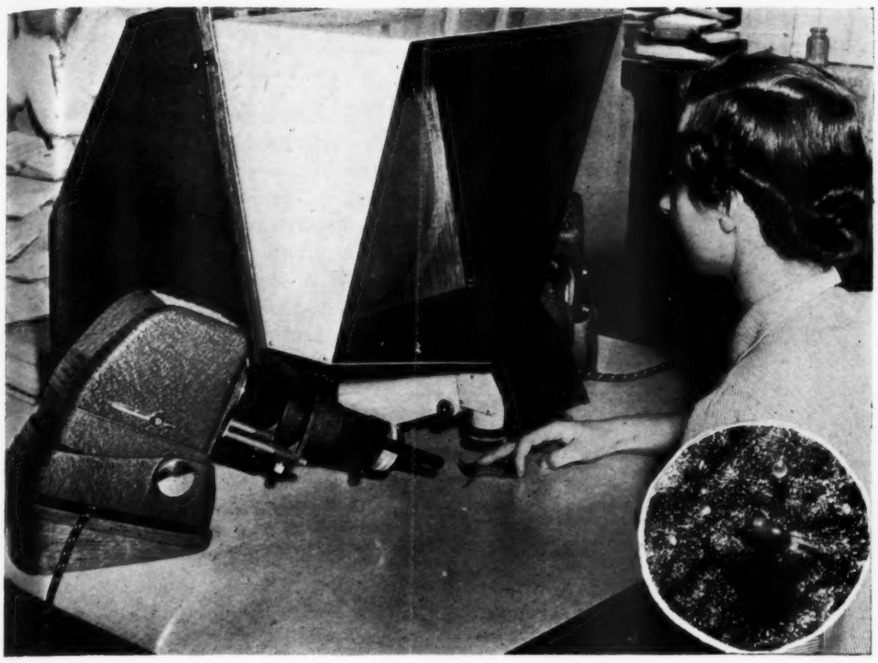
A further facility offered to growers by the Company is a spray warning service, whereby growers are advised of the most suitable time to apply sprays for the control of Red Spider, Codling Moth and other important pests.

Research

The Company is fully equipped to carry out all phases of research work, including



Spraying plants with a test material



Projection apparatus for the counting of mites on leaves; inset shows the type of image projected

synthesis and development of new insecticides and fungicides, investigation and manufacture of new formulations of known materials and investigation of new methods of controlling various pests and diseases.

The normal routine for the development of a new material involves initially the laboratory investigation, by the biological department, of substances prepared by the chemical departments. Materials which show promise from an insecticidal, ovicidal or fungicidal standpoint are then referred back to the chemical laboratory for preliminary investigation into formulation. These first formulations are then subjected to phytotoxicity trials in the Company's own trial grounds or glasshouses, under varying conditions and at strengths considerably greater than those indicated by the preliminary screening tests. If the material passes these tests satisfactorily, larger quantities are prepared and suitable sites selected in commercial orchards, glasshouses or market gardens, where the material can be tested to the best advantage under various practical conditions. Normally, any product which survives these trials is then put into limited commercial production for a second season's more extended commercial trial.

Red Spider control

The entomological department has long made a special study of Fruit Tree Red Spider, and for a number of seasons has investigated its life history and control methods, and published the results of these researches.

Its recent work has shown the great value, under certain conditions, of parachlorphenylbenzene sulphonate (Murvesco PCPBS) as a Red Spider ovicide, on fruit trees and under glass. An article on this subject appeared in the last issue of WORLD CROPS, while the initial work was described in the East Malling Report for 1950.

Smoke fumigation

The Company has also been prominent in the development of smoke fumigation for the glasshouse industry, and details of such research have been published from time to time. A wide range of insecticides and acaricides is available for this purpose. DDT was the first insecticide to be used in this manner, to be followed soon afterwards by Azobenzene Smoke Canisters for the control of Glasshouse Red Spider. Other toxicants available are BHC, lindane, parathion and PCPBS (parachlorphenyl benzene sulphonate). The combined Azobenzene/Parathion Smoke Generator was the first of its kind on the market. In addition to aluminium canister-type smoke generators, the Company also produces compressed pellets and envelope-type fumigators containing insecticidal fumigating mixtures.

Phosphorus insecticides

The Company took an early interest in the phosphorus insecticides, HETP, TEPP and parathion, and has played a prominent part in the furtherance of knowledge of the safe handling and use of this group of compounds. A considerable amount of research has been carried out on the analysis of fruit crops for toxic residues of parathion.

Systemics

As work with these phosphorus insecticides developed, the systemic insecticides schradan (bis-dimethylamino-phosphonous anhydride) and BFPO (bis-dimethylamino-fluorophosphine oxide) came into commercial production, while a research team is turning its attention to the development of new systemic insecticides which, it is hoped, will be more efficient, more rapid in action and less poisonous to mammals. Work in this field has produced valuable knowledge of the activation of systemic insecticides by certain other compounds. Details of this work will be published in due course.

Fungicides

Another field in which research has been active is that of fungicides, particularly for Apple Scab (*Venturia inaequalis*) and Blister Blight on tea (*Exobasidium vexans*), and very efficient mercury preparations have been produced for these two diseases. Possible hazards from mercury residues have been fully investigated and it has been shown that no risk arises from these preparations when they are used as directed.

Export

The Company maintains a separate Export Department which works through agents in most of the important centres of the world. The Export Department has its own advisory service, which can call on all the scientific resources of the Company. Commercial or technical members of the Department visit overseas territories from time to time in order to keep up-to-date with local problems and conditions. An endeavour is made to maintain close liaison with research stations throughout the world, and the Department is always ready to co-operate in the investigation of new problems.

Wherever necessary, special formulations are made to meet the requirements of overseas crops and conditions in cases where suitable products are not available on the home market. The provision of special cotton dusts and anti-malarial sprays are obvious examples.

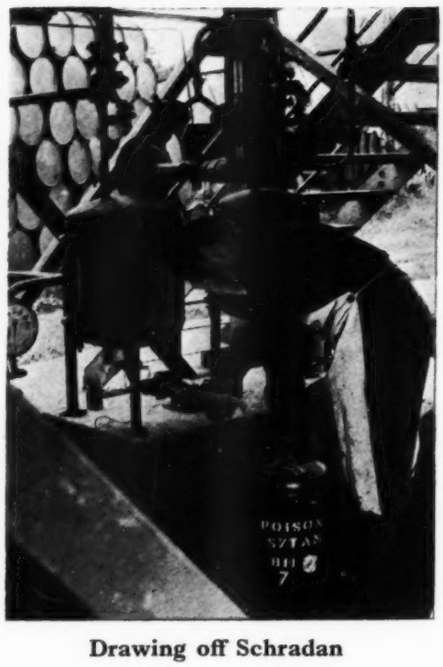
Publicity

The firm regularly issues handbooks and technical leaflets for the guidance of users. These give detailed scientific and practical information on pest, disease and rodent control. The ' Complete Spraying

Programme for Fruit Growers, Hop Growers and Market Gardeners ' for 1952 is a book of 96 pages consisting entirely of information on pest and disease control on a wide range of crops. A book of similar size and value is ' Murphy Insecticides, Fungicides and Fumigants for Nurserymen and Mushroom Growers.'

Liaison with other bodies

Members of the scientific staff of the Company serve on committees of the Association of British Insecticide Manufacturers, Industrial Pest Control Association and other official organisations concerned with the industry. They have played a prominent part in the collaborative work on methods of analysis required for the Crop Protection Products Approval Scheme of the Ministry of Agriculture and in the production of the Ministry's Bulletin of Fruit Tree Bud Stages. As representatives of the above associations they have also been actively concerned with measures to reduce the toxic hazards involved in the handling and use of the phosphorus insecticides, the standardisation of products for recommendation by the World Health Organisation, the standardisation of nomenclature for crop protection materials and other matters of interest and importance to the industry as a whole.



Drawing off Schradan

It has always been the policy of the Company to maintain the closest and friendliest contact with research stations and official workers at home and abroad.

Chile's Agricultural Expansion Programme

PROJECTS involving the expenditure of about 24,000,000 pesos for Chilean agricultural development were approved in Santiago recently by the Chilean Minister of Agriculture and the head of a group of American experts co-operating with the Chilean Department of Agriculture.

The projects cover the following subjects:

(1) *Machinery and Equipment.* This project, which provides for 7,500,000 pesos in expenses until June 30, provides the establishment of garages, purchasing of mechanical equipment, training of personnel and machinery centres.

(2) *Materials and Supply.* This project, with 8,000,000 pesos expenses, is to establish one or several warehouses, according to the requirements, to store and control the supply of materials, tools and other implements bought or received by the Department.

(3) *Agricultural Engineering.* This project provides for the creation of an agricultural engineering section in the Department, which would plan irrigation and drainage of lands; would supervise the construction of small irrigation and drainage works; would improve the agricultural conditions of lands by levelling them; would attain a better use of the irrigation water and would supply drafts for agricultural buildings.

(4) *Agricultural Demonstration Centre.* This project, which will cost 5,796,025 pesos, provides for the purchase of a big farm and its equipment in the zone of Concepcion, in Southern Chile, which is to give scientific and practical guidance to farmers.

(5) *Soil Conservation.* This project will be carried out on the farms of people willing to co-operate in the programme, and will include the study of soils, levelling, construction of terraces and different types of ditches and prevention of soil erosion. Its cost until June 30 will be 929,000 pesos.—*Reuter.*

' Fusarex ' Colour Film

Preservation of the potato is featured in a new sound colour film sponsored by Bayer Agriculture Ltd., copies of which are available to interested parties. The film deals with the losses experienced by growers of seed potatoes and potatoes for human consumption stored in clamps on the farm. It also shows the serious nature of Dry Rot disease of seed potatoes and its control by means of ' Fusarex '.

Beet Sugar in Italy

(From our Italian Correspondent)

THE cultivation of sugar beet in Italy is extensively carried out in the province of Rovigo, which was subjected to disastrous flooding in the winter of last year, upwards of 100,000 acres being affected. The Italian Government immediately undertook very active measures to repair the damage and to stop the leaks in the levees and embankments of the river. By last March, about one-half of the flooded lands had been reconditioned and were capable of being cultivated and by April the cultivable area had again been considerably extended.

The larger part of the flooded area is reserved for the cultivation of sugar beet and the total area destined for this crop is 220,000 hectares as against 200,000 hectares in the preceding season.

Last winter was milder than the average, with little snow or frost, and in consequence the usual action of frost in pulverising the soil and improving tilth was much less in evidence than usual. Preparation of the land for planting began early, sowing being facilitated by the widespread mechanisation that has taken place, and operations were completed during March. During March and April, however, temperatures were below the average and this retarded germination. Simultaneously, rainfall was deficient and this checked growth further so that by mid-April the crop was very backward, a condition which in fact prevailed in all parts of Italy. Subsequently conditions improved, warmer weather being accompanied by seasonable rains.

Nevertheless, the prospects can only be described as moderate, especially as the advantages of early sowing have been offset by unfavourable weather subsequently, while the position has been aggravated by the attacks of insect pests, notably *Cleonus*, particularly in Bologna, Ferrara and Romagna, as well as in Central Italy.

To combat these insect pests a special commissary has been appointed and very active steps are being taken in a campaign in which the National Beet Farmers' Association is collaborating with the sugar factories and the National Committee in the protection of crops. Large amounts of insecticides have been made available to farmers and much dusting and spraying equipment has been transferred to the areas affected.

Much attention is being devoted by the official agricultural authorities to the improvement and extension of sugar beet cultivation.

Aspects of British Colonial Agricultural Law

Part III — Crop Controls

G. B. MASEFIELD, M.A., A.I.C.T.A.
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This is the third and last of Mr. Masefield's trilogy of articles dealing with certain aspects of agricultural legislation in the British Colonial Dependencies. It is concerned with legislative control over cropping operations.

A VARIETY of aspects of colonial legislation can be considered under the heading of crop controls. This article is not, however, concerned with cases where production of a crop is controlled for economic reasons, *e.g.* where growers are required to be licensed in order to avoid over-production. Consideration is here confined to cases where the growing of certain crops is prohibited, regulated or controlled for technical reasons.

Dangerous drugs

The first class of controls to be considered is that relating to the cultivation of crops which provide dangerous drugs. Control is usually accomplished in the Colonies under a Dangerous Drugs Ordinance, and the crops most commonly prohibited are opium poppy, Indian hemp and coca. An examination of the laws of 33 British colonial territories shows that in 17 of them the cultivation of all three crops is prohibited, in four of them opium poppy and Indian hemp are prohibited, and in two Indian hemp only is forbidden. The reason for these discrepancies is not very clear, but they do not mean that opium, hashish or cocaine can be freely produced anywhere, for in most, if not all, of the territories the possession of these drugs, except under licence, is also rigorously prohibited. The prohibition of the coca plant (*Erythroxylon coca*) is in some of the ordinances extended to the related species, *E. novo-grantense*, and in others to any plant of the family *Erythroxylaceae* from which cocaine can be extracted.

Other drug plants are also occasionally prohibited. The Dangerous Drugs Ordinance (1926) of Northern Rhodesia makes illegal the cultivation of *Leonotis leonurus* and *L. ovata*, while in north-eastern Africa the cultivation of 'kat' (*Catha edulis*), the leaves of which contain a habit-forming drug, is prohibited by the Kat Ordinance (1947) in the Somaliland Protectorate and by the Miraa Control Ordinance (1947) in Kenya.

Close seasons for disease control

The next class of prohibitions concerns close seasons, during which a particular crop may not be grown in order to assist control of pests and diseases. Here comparisons between different territories are of great interest. The crop most widely affected is cotton; such measures are chiefly aimed at the control of various bollworms. It is interesting to record, however, that in the West Indies a close season for cotton was originally adopted in order to control other pests and proved invaluable when the pink bollworm was introduced in the early 1920s.[1] Annual dates for close seasons are declared either by the Governor or the Director of Agriculture, most commonly under a local Cotton Ordinance but sometimes under more specific legislation such as the Cotton Diseases Prevention Act, 1928, of Barbados. The usual procedure is to fix a date by which all cotton plants must be destroyed, and it is usually specified that this must be done by uprooting and burning. Several of the West Indian ordinances also lay down that okra plants, which are capable of harbouring many cotton pests, have to be destroyed at the same time. The same provision is made in Nigeria by regulations under the Agriculture Ordinance (1926). In the West Indies the end of the close season is also defined by declaring a date before which the next crop of cotton must not be sown. In some more important cotton-growing countries, such as Uganda, this is not attempted, but an adequate close season is obtained by fixing dates for uprooting some two months before climatic conditions are suitable for the earliest sowings. Legal close seasons for cotton are never less than two or three months and sometimes longer.

No British colony has followed the example of the Union of South Africa, where an Act allows a legal close season for cotton to be prescribed by local option; the first magisterial area to adopt this was Barberton, where the Empire Cotton Growing Corporation have for so long done pioneer research work on the crop.[1]

Tobacco is another crop for which close seasons are, though less commonly, used. Here the way was pointed by Southern Rhodesia, where the Tobacco Pest Suppression Act, 1933, provided the necessary powers. This was specifically aimed at the leaf-curl virus disease which was then very threatening; the measure proved so successful that no further serious outbreaks occurred except where growers had failed to carry out its provisions.[2] Special legislation for the same purpose has been passed for the Virgin Islands in the Tobacco Close Season Ordinance, 1939. In Tanganyika, a Government notice of 1939, under the Plant Protection Ordinance of 1937, imposes a close season for tobacco in the Songea district. In Nyasaland, dates for uprooting tobacco are fixed by the Director of Agriculture under the Tobacco Ordinance of 1950.

Kenya has in certain areas instituted close seasons for maize and sorghum, which are aimed at the control of stemborer and other insect pests. The necessary powers are derived from the Plant Protection Rules, 1939. The annual close season prescribed here is as long as eight or nine months; it has been applied in some of the highland areas only, *e.g.* Uasin Gishu, Trans-Nzoia, Nakuru, etc.

Legislation for close seasons often includes a clause providing that in case of default the authorities may uproot the plants and recover the cost from the defaulter. Under conditions of African peasant cultivation, native authorities are in many territories given power to enforce the uprooting of plants, for example in Tanganyika and in Uganda under the Buganda Kingdom Agricultural Law, 1946.

Control of planting material

The third kind of legislative control to be considered is that of planting material. This is aimed at ensuring that only satisfactory varieties of crops are planted. Cotton is again by far the most important crop to which such measures are applied and they are made possible because with this crop seed supplies become concentrated at the ginneries; it is especially desirable because of the very bad effects which admixture of seed of inferior varieties has on the quality of the lint. The necessary powers are usually provided under the

Cotton Ordinances of the territories concerned, as in Uganda, Kenya, Tanganyika and Nyasaland. The most usual provision is that no grower is allowed to plant seed which has not been authorised for use or issued by the Director of Agriculture. To implement this, the Director is generally given powers to requisition seed from ginneries. No compensation is paid, the loss of this seed being regarded as one of the normal expenses of ginning, and the requisitions are distributed equitably between ginneries by the Director and his staff. These arrangements are fortified by a provision that no one may import cotton seed except with the permission of the Director. Uganda goes a step further with its Cotton Zone Ordinance (1933), which only permits cotton from a defined zone to be purchased at each buying centre. This ordinance helps to prevent the admixture of varieties and the spread of cotton diseases. Tanganyika has adopted somewhat similar regulations in its Cotton Rules, 1949. Most Cotton Ordinances also provide for the establishment of 'segregated areas' in which arrangements can be made for the growing and marketing of particular strains of seed with special precautions against admixture, and for the multiplication of small quantities of seed of new types.

Special arrangements exist in St. Vincent for the propagation of the small but important Sea Island cotton crop. Under the Cotton Seed Control Ordinance, 1935, no grower may plant cotton seed which has not been grown under the control of the Agricultural Superintendent, who may enter into agreements with growers to whom he supplies seed to secure the seed produced from the crop for general planting.

Mauritius has also used legislation to control the varieties of sugar-cane cultivated, the Sugar Cane Plantations (Control) Ordinance, 1945, giving the Governor power to specify the varieties which may be planted. By a proclamation of 1946 these were limited to 12 varieties, and all others had to be uprooted within five years. In Nyasaland, no tobacco may be grown by a native on native land except from seed issued by the Agricultural Department, under the provisions of the Tobacco Ordinance (1950). The Ginger Grass Eradication Ordinance, 1934, of the Seychelles aims at improving stocks of *Cymbopogon* grass grown for the production of essential oil. Under this, it is an offence to cultivate certain inferior varieties of *C. martinii*.

Northern Rhodesia provides an example of local option in varietal control. By the Maize (Local Option) Ordinance (1927), which applies to nine districts only, maize growers in any area may petition the Governor to restrict the varieties of maize grown. The Governor has to publish the petition and call for objections and, if the petition is thereafter granted, the area may be declared and the variety or varieties to be grown prescribed.

In Nigeria, the palm oil industry is largely based on wild palms of genetically poor types, and the effort has been made to foster improvement by legislative encouragement. As an incentive to planting palms of better type, the Cultivated Oil Palm Ordinance (1935) was passed, which gives powers for the remission of export duty on oil produced from cultivated palms, and under regulations (1935-40) this is done in full or in part according to the standard of quality reached by the oil.

Import restrictions may also be used to safeguard the genetic quality of planting material, and in Bermuda under the Agriculture Act, 1930, importers of seed potatoes must satisfy the Director of Agriculture that the potatoes are of an approved strain.

Export of planting material

This leads to consideration of another type of control, namely prohibitions of the export of planting material. Inevitably, under the various commodity restriction schemes adopted in the 1930s, the participating territories bound themselves not to supply seed to countries which were not signatory to the agreements, and rubber and tea were thus affected. Apart from this, there is always a temptation for territories which have a more or less complete monopoly of a crop to prohibit the export of planting material to potential competitors. Two such near-monopolies exist in the West Indies, and both have been exploited in this way. In Jamaica, a proclamation under the Export of Plants Prohibition Law (1925) forbids the export of viable planting material of pimento.[3] In St. Vincent, an order of 1931 under the Customs Ordinance prohibits the export of arrowroot tubers, plants and bulbs except under licence from the Governor in Council. In the Straits Settlements, by an order of 1939, under the Export of Plants (Control) Ordinance, 1939, the export of planting material of derris and oil palms, except to any Malay State, is prohibited except under permit from the Director of Agriculture. But this order does not seem to aim at complete prohibition, since it provides a form of permit for use by the Director on such occasions. It is difficult to see any modern justification for the retention of prohibitions on plant exports, which must be regarded as anachronisms and in any case rarely achieve the desired end. The history of the spice trade in particular is full of examples of the successful smuggling of seed from one country to another in the face of legal restrictions.

Compulsory cultivation of crops

So far we have considered the legal prohibition or restriction of the growth of crops. One other class of legislation which falls to be considered concerns the compulsory cultivation of crops. Temporary war-time legislation of this sort was, of course, applied in many colonial territories which were short of food, but consideration here must be limited to examples of action by permanent legislation. These all concern the compulsory cultivation of rice in territories of south-east Asia. One of the earliest instances comes from the Malay State of Negri Sembilan, where under its Cultivation of Rice Enactment (1917) certain lands were restricted to rice cultivation and were not allowed to be planted to other crops except with the permission of the Collector of the district. The Rice Cultivation Ordinance (1934) of the Straits Settlements went further in the same direction. Under it the Governor in Council may declare any land to be rice land, owners or occupiers of which are required to cultivate all of it in rice at least once during each year. In North Borneo, the Native Rice Cultivation Ordinance, 1939, contains similar provisions.

Fuel supplies

Finally, in a class by themselves, must be considered two curious cases in which the cultivation of the crop is tied to the maintenance of wood fuel supplies. The cultivation of pyrethrum and tobacco require wood fuel for their drying and curing, and this has in some countries led to a serious denudation of fuel supplies. Thus in Kenya the Pyrethrum (Planting of Trees) Rules, 1948, require every licensed grower of pyrethrum to maintain an acreage of natural forest or timber sufficient to provide fuel to dry his crop.

In Nyasaland, the Tobacco Ordinance, 1950, gives the Governor power to declare any area a controlled area if necessary for the conservation of natural resources, and in such areas the Director of Agriculture may refuse to issue tobacco-growing permits if steps have not been taken to ensure the maintenance of adequate supplies of timber for fuel in tobacco curing.

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2. H. H. Storey: *Basic Research in Agriculture: A Brief History of Research at Amami*, 1928-47.
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NEW BOOKS

Soil Physical Conditions and Plant Growth

Edited by Byron T. Shaw. Pp. xv and 491. Academic Press Inc., 1952. $8.80.

It is difficult to evaluate, even qualitatively, those physical factors which affect the growth of a crop. Although physical properties largely determine the value of soil there are no quantitative expressions for practical descriptions such as 'soil in good heart.' A joint Committee of the American Society of Agronomy and the American Society of Agricultural Engineers, formed to establish methods for measuring and evaluating soil tilth, was dissatisfied with the existing approach through empirical field experiments. They suggested that in new studies of the effect of farming practices on plant behaviour the problem should be broken down into manageable parts and as a first step sponsored the production of this monograph.

In an opening chapter L. T. Alexander describes soil as a physical system and discusses the influence of the profile, mechanical composition and chemical characteristics on soil structure. H. E. Middleton describes how physical properties may be modified by agents 'varying in character from a fungus to a 75 horsepower tractor.' The four chapters following review in detail the effects of mechanical impedance, soil water, temperature, and aeration on crop growth.

J. F. Lutz deals with mechanical impedance, a difficult subject but of the greatest importance. There is a concise and critical review of American work on deep subsoiling but the reviewer would have appreciated a more complete account of experimental work on deep cultivation.

L. A. Richards and C. H. Wadleigh review an extensive literature on soil water relationships, discussing water movement in soils, irrigation, drainage, methods of measuring moisture tension and the influence of soil moisture on mineral nutrition and physiological processes. They give a particularly useful review of field experiments on irrigation and the factors affecting water requirements of crops.

M. B. Russell discusses the influence of aeration on chemical and biological soil processes, on root growth and on plant diseases; he deals at length with the absorption of water and nutrients in relation to aeration.

In the last chapter S. J. Richards reviews methods of measuring soil temperature and factors which affect this important soil property, while R. M. Hagan deals with the effects of temperature on growth. T. M. McCalla contributes sections on the effects of temperature on growth of micro-organisms and of management practices on soil temperature.

Throughout this volume there is a strong critical spirit, the authors stressing that much information relating crop growth to physical factors is based on inference rather than on quantitative data. A final chapter might have been expected integrating the separate discussions, but in a brief epilogue the Editor refuses to deal with relationships that cannot be put on a quantitative basis. He emphasises that the next steps are to obtain better measurements of the effects on plant growth of the four physical factors dealt with in terms which can be interpreted and also to study their interactions.

The authors have done a good service to soil scientists by their critical reviews and by bringing the results of much scattered work together. This volume, which will be widely welcomed, will form valuable reading for students and research workers and should serve as a work of reference for crop husbandry specialists.

G. W. Cooke

Fodder Beet

By P. J. Boyle. Pp. 78. Commonwealth Agricultural Bureaux, Farnham Royal, 1952 (mimeographed). 5s.

Fodder beet, which is the result of crosses between mangolds and sugar beet, has of late years attracted considerable attention. It is a comparative newcomer to the agricultural scene and was first introduced into general farming in Scandinavian countries and the Netherlands in the 1930's, where it has attained wide popularity; in Denmark, for instance, it is the most widely cultivated fodder root crop.

Extensive experiments with the crop have been carried out in these countries, the results of which are not widely known outside them. Interest in the crop in Britain has expanded latterly, and it is in response to a widely expressed desire for information that this publication, which attempts to assemble general information on and the main results of experiments with the crop, has been undertaken.

The result is the production of a highly informative and very complete review. Conditions in Holland and Scandinavia approximate sufficiently to those in Britain to warrant the belief that the crop would be well suited to British conditions and to British farmers and others interested in the matter this comprehensive account of the husbandry of the crop can be cordially commended.

To Authors and Readers

The Editor and Publishers of WORLD CROPS will be glad to consider manuscripts of books submitted for publication. We already publish a number of books on technical subjects, all of which find a world sale and most call for regular reprints and new editions.

Books of a non-fictional type in any language by any publisher can be supplied by the Book Department of WORLD CROPS.

The Production and Marketing of Rice

By J. N. Efferson. Pp. 534. Illustrated. *The Rice Journal*, New Orleans.

Although there exists an extensive literature on rice, this is the first comprehensive account of the production and marketing of this cereal throughout the world. The author has expert knowledge of the rice industry in the United States and has enjoyed unique opportunities of observing at first hand the rice producing industry in all the more important centres of production.

Part I discusses the world rice situation, the botanical and other characteristics of the plant and world rice problems. In Parts II, III and IV, the rice industries of Asia, Africa, Europe and Latin America are described, including brief summaries of production methods and a more detailed account of rice marketing, particularly in relation to the possibilities for development of American markets in each centre. Part V, devoted to the rice industry in the United States, gives a more detailed description of the industry in that country than is accorded to its cultivation in the more important centres of production.

In the author's own words his book 'is designed to cover the important phases of the production and marketing of rice in all major world regions. It is not a detailed technical book from the standpoint of the agronomist, the plant breeder or the economist. The objective was to present a broad general picture of rice in all its variations for the information of the

student, the farmer and the many segments of the rice industry.' The book, therefore, has its limitations; the student and the farmer may find much useful information in this volume, but serious omissions make the book less useful to both students and farmers than might have been the case. The absence of reference to pests and diseases is a major omission, while irrigation, the use of fertilisers and manures are given less consideration than they deserve. The emphasis is on marketing, rather than on production; consequently, despite the author's disclaimer, the economist may be more attracted to this book than the producer. Mr. Efferson's book is best considered as complementary to *The Rice Economy of Monsoon Asia*, by Wickizer and Bennett; together the two books cover the subject of the production and marketing of rice throughout the world without going deeply into the technical aspects of rice production.

While there are numerous printer's errors in Mr. Efferson's book, and examples of very loose construction, it would be ungracious not to comment favourably on the numerous excellent illustrations which adorn his book.

D. H. GRIST.

Textbook of Wood Technology

Vol. II. By H. P. Brown, A. J. Panshin and C. C. Forsaith. Pp. 783 + xxv. Illustrated. McGraw-Hill, New York, 1952. $10.

This volume deals very comprehensively with all the physical and mechanical properties of wood and includes a short section on the chemical properties but does not attempt to deal with the innumerable chemical derivatives of wood. Each of the main subjects in the first two classes is clearly handled and for the student the various problems of application worked out in the text are very useful. These appear at their best in the sections dealing with 'Framed Structures' and the 'Holding Power of Timber Fasteners.'

All the sections are illustrated with excellent diagrams. There is little occasion for criticism, but it would be fairer to the student if it were made clear that most of the safe working stresses laid down for timber have been arbitrary estimates though based on general experience in use except where genuinely stress-graded timber is used. To say that the factors responsible for the discrepancy between computed theoretical strength and actual strength are under scrutiny is hardly enough.

While it is recognised that the work is intended primarily for use in America and that the U.S.A. has led the way in scientific timber-testing, it would have been an advantage to the student to mention, if not discuss, the testing practice of other countries, such as the use of sub-standard test pieces which European countries find themselves obliged to use, as no doubt will the U.S.A. in the not distant future when it has used up its virgin forests.

References to foreign literature are scarce but it may be considered that in a work virtually confined to American species foreign experience is not important.

These are, however, minor points which do not seriously detract from the marked usefulness of the work and the book should be studied by all concerned with any type of wooden construction, whether packages or public halls.

W. A. ROBERTSON.

New Publications

The following books, published recently, are available from the Book Department, WORLD CROPS, Leonard Hill Ltd., Stratford House, Eden Street, London, N.W.1.

Botany: A Labour Manual, by T. E. Weier, C. R. Stocking and J. M. Tucker. Pp. 140. Chapman and Hall. 18s.

British and Dominion Textile Industry, 1952. Pp. 626. J. Worrall Ltd., Oldham. 27s. 6d.

Farm Mechanisation Handbook, by T. H. Cradock. Pp. 368, illustrated. Temple Press. 10s. 6d.

Food Canning. Pp. 28, illustrated. Anglo-American Council on Productivity. 7s. 6d.

Food Science, edited by E. C. Bate-Smith and T. N. Morris. Pp. 320, illustrated. Cambridge University Press. 40s.

Fruit and Vegetable Utilisation. Pp. 56, illustrated. Anglo-American Council on Productivity. 4s.

The Law of Waters and Land Drainage, by H. J. W. Coulson and U. A. Forbe. Pp. 1248. Sweet and Maxwell. £8 8s. 0d.

The Useful and Ornamental Plants of Trinidad and Tobago

By R. O. Williams, O.B.E., and R. O. Williams, Jnr., A.I.C.T.A. 3rd Edition. Pp. 335. Guardian Commercial Printery, Trinidad. 1951. $2.

This is the third edition of a useful manual first published in 1927 when the senior author occupied a post in the Trinidad Department of Agriculture. He was transferred to Zanzibar some years ago and the present revision was accomplished there in concert with his son, who now occupies a post in the Kenya Department of Agriculture. The possibility of revising it under Zanzibar conditions must be due to the help the authors received from many authorities in Trinidad, which is suitably acknowledged in the preface.

The book itself contains a popular account of the useful and ornamental plants to be found in Trinidad, arranged in alphabetical order, preceded by a series of keys intended to enable the student to identify readily any plant he may wish and to follow this up by consulting the fuller details to be found in the larger part of the work.

One cannot fail to be impressed by the care and attention which the two authors have devoted to their task and to congratulate them on the result.

A point which is bound to impress the reader is the number of species of plants foreign to Trinidad which have been introduced there by the authorities during the period it has been a British colony.

The book can safely be commended to all those who desire a useful handbook to the botanical wealth of these beautiful and attractive islands in the Caribbean.

The Potato Yearbook

The 1952 edition of the American Potato Yearbook is again edited by John C. Campbell, of Rutgers University College of Agriculture, and contains 79 pages of useful information to the potato grower, and all interested in the potato industry.

Of special significance is the excellent illustrated article on 'Recent Developments in the Use of Portable Irrigation Systems in Potato Production Areas,' by Arthur J. Pratt, of Cornell University. Another feature is the list of research projects with the names of individuals engaged in conducting research on Irish potatoes in every part of the country.

Other interesting items include articles on scab control, temperature and potato storage, rules and regulations affecting the shipments of seed potatoes, a list of leading United States and Canadian associations engaged in the improvement of the potato industry, together with the names of United States and Canadian seed certification officials.

The volume also contains much statistical information of value. Copies may be secured from the Editorial Office, 319 Scotch Plains Avenue, Westfield, N.J., price $2.00.

FARM MACHINERY

Brazilian Cotton Successfully Picked By Machine

(*Left*) **The McCormick International cotton picker at work in Brazil.** (*Right*) **A sample row after the picker has been through**

Satisfactory results have been reported during the recent harvesting season by several McCormick International cotton pickers operating on fazendas in the important cotton-growing areas of Brazil.

With 4,600,000 acres of cotton under cultivation last year, Brazil is the fifth largest cotton producer of the world, ranking behind the United States, China, India and Egypt. Last year it produced 1,500,000 bales (340,000 tons) of cotton, equal to roughly 4% of the 34,765,000 bales (8,343,600 tons) grown in 45 countries. Easily the leader among South America's seven cotton-producing countries, Brazil also accounted for 57% of the total crop of that continent.

The pickers, which operated in fields at Oswaldo Cruz, Guaira, Jaboticabal, Barretos, and Paulo de Faria, are among the first mechanical cotton pickers to be used in the country. According to field reports, they operated quite satisfactorily even though the cotton crop was below average, had been planted in irregular rows and received little or no cultivation. In addition, the fields had not been cleared properly of weeds, trash, small stumps and branches which presented a hazard to the spindles and picker arms of the machines.

Until recent years, fields of cotton as commonly seen in the U.S. and other countries were unknown to Brazil. As a rule, cotton has been grown by the small farmer with little capital, and it has been the custom for the crop to be grown and harvested largely by primitive methods. Such preparatory steps as breaking the soil or laying out the furrows are often dispensed with and the farmer may only clean the land and plant the seed at the proper season. There is usually very little cultivation except for occasional weeding of the fields with the hoe.

Although it was thought that the cotton pickers would operate poorly under such conditions, as they function best on level land free of soft, low spots with rows planted uniformly 38 to 42 in. apart, one plantation owner in Sao Paulo reported he was able to harvest an average of 6,600 to 7,700 lb. per day with only one picker.

Previously, 350 workers had to be transported to the farm to pick the cotton by hand. After the picker's arrival, the only manpower needed were 15 regular farm hands who sacked the cotton before it was hauled to the gin.

Improper operation of the picker was kept to a minimum through a rigid schedule of machine lubrication and a programme prepared by International Harvester Maquinas, S.A., the I.H. Brazilian affiliate company, to teach operators and owners how to use the pickers to their advantage. Minor maintenance problems were corrected at the service stations of the International Harvester dealers who supplied the machines.

Some damage occurred when the pickers were operating at night to take advantage of better moisture conditions, as the cotton is more easily picked and doffed by the machine when the picking spindles are moist. During daytime operations, however spotters walked in front of the machines and removed from the rows obstacles that might have slowed down operation.

One of the first production models of the Hudson Mounted Disc Plough (see 'World Crops,' May 1952, p. 185), working in heavy red soil, sunbaked and hard, in Southern Rhodesia

Change of Address

The firm of Kenneth Hudson and Son has now become a member of the Owen Organisation, whose headquarters are at Rubery, Owen and Co., Ltd., Darlaston, South Staffordshire. In order to facilitate more economic production of agricultural machinery, more commodious premises have been provided at Darlaston for the works of Kenneth Hudson and Son, now at Elland, Yorkshire.

Since January 1, 1950, Kenneth Hudson and Son have embarked upon the design and marketing of entirely new and specialised products and three of these—the Multi-Row Beet Topper, the Mounted Disc Plough and the Twin Disc Hoes—are now well known.

The executive staff of the firm includes Mr. A. S. Heggie, General Manager, previously employed at Ford Motor Co., Ltd., Mr. J. H. Nicholls, A.M.I.B.A.E., Chief Designer, and Mr. J. France, A.M.I.Mech.E., A.M.I.Prod.E., Production Manager, both previously employed at David Brown Tractors.

Many export orders for the Mounted Disc Plough are being fulfilled, and in this connection Kenneth Hudson and Son will take advantage of the facilities provided by the Owen Export Organisation, and export enquiries should be addressed to Kenneth Hudson and Son, Kent House, Market Place, Oxford Circus, London, W.1.

WORLD CROP REPORTS

U.S.A.

The wheat outlook, 1952-53. The supply of wheat in the United States, beginning July 1, 1952, was expected to be large enough to meet all domestic and export needs. A production of 1,286 million bushels may be realised in 1952, based upon crop conditions on May 1 and assuming a normal growing and harvesting season. A carry-on of 270 million bushels, plus imports of 40 million, and possible production of 1,286 million would provide 1,596 million for all uses. If realised, this supply would meet American needs during the 1952-53 crop year and the carry-over would be increased at the end of the period, because it is expected that more wheat will be produced than is used.

The world supply of wheat for export or carry-over in the four principal exporting countries (United States, Canada, Australia and Argentina) on March 1, 1952, amounted to around 820 million bushels, according to U.S.D.A. reports. The 1951 world bread-grain production was estimated at about 242 million short tons, which is the second largest bread-grain crop on record. The record was established in 1938. The world wheat crop is estimated at 6,500 million bushels, which is about 475 millions above the pre-war 1935-39 average. Argentina has had small supplies for export, due large to unfavourable weather conditions and low prices to producers. (*From a report issued by the Extension Service, Kansas State College.*)

SYRIA

Increased oilseed production. Syria's production of vegetable oilseeds in 1951, excluding olives, totalled about 98,000 short tons, an increase of more than 30% from the volume produced in 1950, according to the American Legation, Damascus. The increase in total oilseed output was due entirely to the expanded cotton cultivation in 1951 following the highly remunerative cotton yield of 1950. The expansion in cotton acreage, however, reduced areas devoted to other oilseeds with subsequent reductions in output. The average yields for most oilseeds were low because of an insufficient supply of irrigation water. The commercial cottonseed crop of about 90,940 tons, although half again as large as in 1950 and about 93% of the total 1951 oilseed crop, was not proportionate to the area planted because of insect damage.

Sesame cultivation suffered most from the increase in cotton acreage, with only 2,200 tons being produced in 1951 against 6,600 tons in 1950. Other oilseeds produced in 1951 were apricot kernels, 1,870 tons; hempseed, 1,760; linseed, 550 (19,680 bushels); groundnuts, 440; castor beans, 220 and sunflower seeds, 60 tons.

Vegetable oil production in 1951 was estimated by trade and industrial circles at 6,580 tons, compared with 6,210 tons the year before. Cottonseed oil at 5,510 tons made up most of the 1951 output. In addition, olive oil production in Syria amounted to about 6,610 tons, an increase of one-half from 1950.

AUSTRALIA

Not enough rice. The whole of the Australian rice crop now being harvested —probably less than 40,000 tons—will be less than the Federal Government's commitments for overseas and local priority users, according to the secretary of the Australian Rice Association. He said rice had to be supplied to the New Hebrides, Papua, Borneo and Saudi Arabia, as well as to Australia's 15,000 Chinese and to the crews of visiting ships.

Last season's crop came to 75,000 tons unmilled and early estimates for the current crop were in the region of 58,000 to 60,000 tons, all from the Riverina. Scores of acres had, however, been eaten by ducks.—*Reuter.*

INDIA—PAKISTAN

43% increase in jute production estimated. The final estimate for the production of raw jute in the Indian Union and Pakistan together, for the year ended June 1952, is 11,008,000 bales, according to the Indian Central Jute Committee (1 bale (Government of India) = 400 lb.). This is a considerable increase on last year's figure (1950-51), which was 7,657,000 bales.

The broken down production figure for 1951-52 shows 4,677,000 bales from India and 6,331,000 bales from Pakistan, compared with 3,301,000 and 4,356,000 bales respectively in 1950-51.

Coffee estimates.—The Indian Coffee Board estimates the 1951-52 crop to be 14,200 tons of Arabica and 6,500 tons of Robusta, making a total of 20,700 tons. Preliminary estimates of the 1952-53 crops have been placed at 13,000 tons of Arabica and 8,000 tons of Robusta, totalling 21,000 tons.

INDONESIA

Home sugar output. Sugar factories in Central Java, which closed down recently, have almost all reopened. They include 14 with canefields attached, covering an area of 13,000 hectares. The yield from these alone is estimated at 1,500,000 quintals, valued at Rp.378 million, according to official Indonesian information.

Estate production. According to the Indonesian Central Bureau of Statistics, estate production for the last three years and for one year pre-war has been as follows:

	1938	1949	1950	1951*
	(Production in 1,000s of kilograms)			
Rubber ..	175,078	170,867	177,319	217,616
Tea ..	80,538	27,269	35,281	46,279
Coffee ..	45,579	10,877	10,600	11,892
Cinchona bark	10,955	6,513	5,670	9,085
Cocoa ..	1,584	853	866	873
Sugar ..	1,375,510	223,309	227,158	427,793
Palm oil ..	226,668	118,777	126,476	121,260
Palm kernels	48,036	13,909	30,774	29,751
Hard cordage fibres	40,769	2,492	7,021	16,059

* Provisional.

FINLAND

Anxiety over grain harvest. Exceptionally dry, cold weather prevailing in Finland during May has retarded the growth of grain crops, according to recent reports. Rainfall during the month was only about a third of normal and frequent frosts were reported. Unless conditions are exceptionally favourable, during the remainder of the growing season, the outlook for the harvest during the current season is poor.

The unfavourable outlook for grain crops may further reduce Finland's degree of self-sufficiency in grains, which has been a subject of considerable concern in Finnish agricultural circles. It is pointed out that the percentage of consumption requirements covered by domestic production has been declining, and reached a low point of 55% in the current season. This contrasts with the pre-war average of 80 to 90%.

No official acreage estimates are yet available. Some increase is expected in acreage under winter wheat. Interest in the earlier ripening winter wheat has been increasing, especially in northern parts of the country. Winter wheat acreage has been only about one-tenth of spring wheat acreage. However, damage to spring wheat in western Finland in 1951 caused by black stem rust is believed to have discouraged farmers from seeding the usual amount of spring wheat this season. Some of the acreage formerly seeded to spring wheat has been put into barley and oats this year.—From *Foreign Crops and Markets.*